Contents—Apr. 1948

Volume XXIX No. 4

ARCHIVES OF PHYSICAL MEDICINE
(Formerly Archives of Physical Therapy)
30 North Michigan Avenue, Chicago 2, Illinois

Published monthly at Chicago, Illinois, by American Congress of Physical Medicine.

Entered as Second Class Matter, February 15, 1945, at the Post Office at Chicago, Illinois, under the Act of March 3, 1879.

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EDITOR OF THE MONTH

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CHALLENGE TO PHYSICAL MEDICINE *

HART E. VAN RIPER, M.D.

Medical Director, The National Foundation for Infantile Paralysis

NEW YORK

Not too many years ago one of our schools of medicine allocated a total of four hours to the subject of physical medicine during the four years of undergraduate instruction. These four lectures had been attended, when convenient, by the members of numerous classes, and one enterprising student had prepared a mimeographed set of lecture notes, complete with "program annotations." Tradition, and the thumbworn notes of the lecturer, dictated that the course be opened with the statement, "There are two kinds of water — hot water and cold water." The students took their cue and in chorus responded, "Three! Wet water."

The past three decades have witnessed real progress in the field of physical medicine. A few schools of medicine have established sections in this specialty, and they are recognized as equal to medicine, surgery and other major departments. In other schools one may find little evidence of the importance of the specialty in the curriculum of study. Indeed, there exists today some feeling on the part of other of your colleges in the healing arts that you are perhaps a too lusty offspring of your hot and cold water progenitor. To those of you who resent your failure to receive due recognition, let me remind you that in many schools of medicine the older specialties of orthopedics, pediatrics and gynecology have not yet been accorded full recognition at the Dean's council table.

The impatience of youth, and its energy, have overcome many of the obstacles to progress and development which have appeared as insurmountable road blocks to those who have become weary in exploring new fields in medical science. The Congress of Physical Medicine brings together a group interested in a new means of therapy, and you members are sometimes guilty of irking your elders by your insistance that you deserve equal prestige and recognition before you have established your ability to walk — let alone run.

As the specialties have developed in the science of the healing arts, certain apprehensions have arisen in the minds of other groups. Each new group, in order to find a sphere of activity, has necessarily trespassed upon what has been held to be sovereign territory of another. Physical medicine, on the offense, has gathered momentum, though you must admit there has been an abhorrent lack of unified command. The defense, while scattered, has been more coherent and vociferous.

Why has physical medicine been so susceptible to criticism? One finds reference to the use of physical agents in the treatment of disease and injury in the writings of Hippocrates. Through the centuries the cults have adopted the principles of physical forces as the foundation upon which to erect their own concepts of the diagnosis and treatment of disease. Medicine now finds itself in the peculiar position of using a therapeutic measure that it has neglected in the past and often has vigorously condemned. Also, one must appreciate the vulnerability of the members of the profession who have awakened to the therapeutic value of heat, light and electricity in the management of their patients, if not the monetary return. Now they are confronted with a public increasingly aware of the importance of this special method of

* Read at the Twenty-Fifth Annual Session of the American Congress of Physical Medicine, Minneapolis, Sept. 3, 1947.

treatment, that requires more than a machine and the "know how" to flip an electric switch.

During the past decade physical medicine has received a real impetus from the following sources: Miss Elizabeth Kenny, The Baruch Committee on Physical Medicine, the expanded activities of the armed services during and following the war and, lastly, the programs of education and research of The National Foundation for Infantile Paralysis. I can recall no other specialty group that has made the debut under more auspicious circumstances.

There are few, if any, branches of medicine that do not benefit from your methods of treatment or research. The doctor of medicine, perhaps more than any other professional man, is disposed to view with skepticism the untried and resists the adoption of newer technic until he has familiarized himself with their operation. His own acquisitiveness and the force of public opinion are operating to interest him in your contribution to the care of his patients. Until such time as sufficient numbers of qualified physiatrists are available to serve as directors of departments of physical medicine, and so be available as consultants in our medical centers, the physician is responsible for the treatment — and with it is accountable for prescribing and supervising such treatment.

The physical therapist and occupational therapist are to the physiatrist what the graduate nurse is to the physician. All too frequently they are criticized unjustly for assuming authority beyond their right and are required to accept responsibility which should not be expected of them. A broad educational program must be energetically prosecuted to inform physicians of the value of physical medicine, pointing out to them their responsibilities to the therapists and to the patients.

I have but casually alluded to the importance of physical medicine in poliomyelitis. The care and treatment of patients with this disease alone would more than justify the monetary expenditures that have already been made and which will continue to be made in support of the further training of professional personnel skilled in the technics that do much to relieve the suffering and prevent the disabling deformities of this disease. Until such time as research uncovers the mysteries of the virus and we know how to prevent infection with it or have a specific therapeutic agent that will cure the patient, treatment will necessarily be symptomatic in its approach.

The pattern of treatment for the patient with poliomyelitis has been changed during recent years. Orthopedists no longer assume full responsibility for the patient's care. Clinical investigation and research have resulted in a greater interest on the part of internists and pediatricians and an awakening on the part of physicians generally to the fact that poliomyelitis is an acute febrile disease; that complications frequently occur that are separate and apart from the disease, whose primary symptoms are those referable to the neuromuscular system. In other words, these patients require complete medical care.

The question naturally arises, whose is the responsibility for the treatment of the poliomyelitis patient? The answer appears obvious: the attending physician, who may be an orthopedist, pediatrist, internist, physiatrist, neurologist or the general practitioner of medicine, who, outside our medical centers, must be recognized as the corner stone of American medicine. All have a real contribution to make, and, regardless of who may be directly responsible for the care of the patient, the other specialties, even in the uncomplicated cases, have a place in the total program of care.

Until such time as physicians understand the principles of physical medicine, its technic will be used and abused along with the ancillary personnel,

not alone in the treatment of poliomyelitis but in all other diseases which can benefit from the proper use of physical agents in the treatment of disease.

Basic to therapeutics is the tedious research necessary to understand the mechanism by which results are obtained. Heat, cold, electrical stimulation and even passive motion and massage, as prescribed in physical medicine, are each one a form of treatment to which patients react and respond in as unpredictable a manner as does a patient who is being treated with morphine, digitalis or a biological.

If spasm is present in poliomyelitis, what is it? What is the relation between muscle spasm and subsequent paralysis and/or recovery of the muscle affected? Is muscle spasm actually relieved by moist heat? If so, what is the mechanism involved? Is it a nerve reflex, acceleration or deceleration of circulation or heating of one or more specific tissues? Can we explain a person's susceptibility to heat or cold, and are we doing damage to tissue structures and disturbing physiologic function by the use of such agents? If these and similar questions could be answered, we might develop a more effective or less costly means of treating poliomyelitis.

To answer these questions considerable sums of money are being made available. In addition, many departments of physical medicine are being equipped for our general hospitals, such equipment replete with chrome and other frills that will not make the transition of knowledge from the laboratory to the treatment center one bit less arduous. In the fervor for mechanization and fancy equipment, pools are being discarded for tanks that will not permit underwater exercise, and the welfare of the patient is being sacrificed in order that eye appeal may not be lost. A gas burner can still heat water; a hand wringer may still extract moisture from a blanket. Ingenuity and a will to bring to the patient the full advantage of our "know how" is a challenge to physical medicine.

You have obtained your objective; you must now consolidate your gains. Standards must be established and maintained, these to cover both education and practice, and their establishment and maintenance must be the joint responsibility and objective of all the groups here represented at this meeting. The physiatrist, physical therapist and occupational therapist must present a united front. Weakness and deficiencies of one will bring but discredit to the other. Your combined talents directed in a synchronized and unified program for the care of the patient will win you the respect of your professional colleagues and the gratitude of a public that is today demanding your ministrations far beyond your ability to provide.

The discussion of this paper will be published in a later issue of the ARCHIVES.

TESTS AND MEASUREMENTS IN PHYSICAL MEDICINE *

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Tests and measurements in varying forms are routine procedures in the average physical medicine department. Manual muscle testing, goniometry, strength tests, measures of work capacity and work tolerance, as well as the many tests of daily living, are familiar to the physiatrist and the physical therapist. The importance of such tools of evaluation must not be underestimated if physical medicine is to offer optimal service to the sick. Implicit in this optimal service is the utilization of the best of available therapy and the improvement of such service through expansion of professional knowledge by means of valid and reliable research.

Tests and measurements form part of the diagnostic equipment upon which the physiatrist relies for accurate evaluation of the original status, progress and residual disability of the patient and upon which he should depend for an estimation of the efficacy of various forms of treatment. For the physical therapist they are important adjuvant tools for motivating patient interest in progress under treatment. Without such means of evaluation and motivation a physical therapy clinic may be reduced to stereotyped therapy which contributes little to professional growth and may be of questionable benefit to the patient.

The purpose of this paper is to present underlying principles of tests and measurements as they relate to physical medicine and to indicate such fundamental procedures as are necessary for their use as clinical tools.

Instrumentation

Of first importance is instrumentation which includes, not only the test or tests to be used and the mechanical devices which may be necessary to the test, but also the technic of administration. Selection of the test is the major step in instrumentation, and upon this choice rests the ultimate value of the results. Proper instrumentation depends upon three interrelated factors; one, clarification of objectives; two, reliability of instrumentation; and three, validity of the test device selected.

Clarification of Objectives. — The objective to be achieved should be defined and clearly stated. *What* is to be measured and *why* must be determined before the *how* can be selected. The general characteristics and purpose of a particular test must, obviously, bear a considerable degree of relationship to the objective to be achieved. One particular test, excellent for patient motivation, may give a record in units too gross to permit accurate and objective determination of progress under treatment. On the other hand, a record which differentiates between the efficacy of two types of therapy or measures progress, however slow, may be presented in unit terms too fine to be meaningful to the patient. It is also important, when considering objectives, to determine the degrees of test reliability and validity essential in the light of objectives to be achieved. Refinements of measurements which demand extreme precision and skill of administration may lead to unwarranted use of time, equipment and personnel, whereas acceptance of gross results may nullify the major purpose of the

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* Read at the Twenty-Fifth Annual Session of the American Congress of Physical Medicine, Minneapolis, Sept. 3, 1947.

testing procedure. Therefore, the first step in the orderly sequence of testing is the clarification of objectives.

Reliability of Instrumentation. — The reliability of instrumentation will be considered first from the standpoint of the tool and then from that of technic of administration. By and large, a high degree of reliability is essential in any testing program. A tool is of little value if the estimations obtained from its use cannot be depended upon for accuracy. A test should be so constructed that, with repeated administrations under controlled conditions, the results will be similar and any differences which do occur fall within a known margin of error significantly smaller than anticipated results. Mechanical tools, especially those with moving parts, should be kept in optimal working order if reliance is to be placed upon resulting records.

Reliability of results can be increased or decreased in the process of administration of a test since the reliability of the person who administers the test affects test results. Careless or irregular procedure or inaccurate observation of results may render conclusions worthless. The human variability of the subject, particularly the untrained one, so dependent upon biologic, physiologic and psychologic make-up, must be recognized and every effort made to elicit maximum cooperation through understanding and constant stimulation of interest. Standardization of test administration will eliminate or minimize many variables inherent in any testing technic and will tend to increase the reliability of the operator.

The degree of reliability of instrumentation may vary within certain limits, depending upon the objectives set up and upon the degree of precision necessary to meet these objectives. It is desirable to know to what extent instrumentation is dependable. In many instances test reliability can be established and expressed statistically in terms of the coefficient of reliability (correlation). Ideally, this should be done wherever possible. Determination of test reliability is accomplished by administering the test under consideration a second time to the same group of subjects under identical conditions. The second set of scores should be consistently similar to and have a good correlation with the first set. If test reliability established in this manner is high, it also indicates that the reliability of the operator is high. However, a low correlation may be due, not to deficiencies in the test, but to the unreliability of the person giving the test. In this case the technics of administration should be subjected to careful scrutiny for undue variability before the test itself is questioned. Reliability is generally conceded to be poor if the coefficient of correlation is less than +0.75. It is not wise, however, to hold rigidly to an arbitrary figure, since it is possible that peculiar or unusual circumstances may justify provisional interpretation of results when a lower reliability figure exists.

Validity of the Testing Tool. — The validity of a test or measurement is the fidelity with which it measures that which is purports to measure. It is, generally, more difficult to establish than is reliability; and, in physical medicine which deals primarily with the complex functioning of the human machine, this is particularly true. Nevertheless, this situation in no way minimizes the importance of validity. In the field of tests and measurements two types of validity are recognized: true and presumptive validity. When an independent and acceptable criterion exists with which to compare the test under consideration, true validity can be determined. The test criterion and the proposed test are administered to a group of subjects, and the scores of the tests are compared statistically by means of correlation. It is not possible to state authoritatively at what point on the correlation scale a testing tool is considered valid. An acceptable degree of validity depends upon the char-

acter of the test and its purpose as well as upon the reliability and validity of the criterion used for comparison.

When true validity cannot be established for lack of an acceptable criterion, presumptive validity must then be relied upon. Validity is presumed to be present when analysis indicates that both the test and that which is tested are comprised of identical or closely similar elements. The test must measure these elements. Thus, a test to measure the strength of an individual muscle would be valid if kinesiologic study shows that in the movement performed for the test the particular muscle to be measured plays a dominant part. Presumptive validity is often open to criticism but can be completely acceptable if proper and careful analysis forms the basis of the presumption.

First principles, then, in tests and measurements deal with instrumentation, the choice of which will depend upon three factors: clarification of objectives; reliability of the tools, procedures and the operator; and the validity of the tests or measurements used.

Statistics

Statistics are a tool common to all languages and, when properly used, are the means by which data can be handled objectively and the results of work interpreted in indisputable terms. They are the instrument utilized to substantiate or refute theories and ideas based upon observation, reasoning and clinical experience and empiric conclusions which may have resulted from nothing more than long usage and tradition. They are indispensable to the worker in both the laboratory and the clinic. The higher intricacies of this useful field need not be mastered in order to make use of the fundamental basic processes referred to in this paper. Any good elementary text will yield, with some small effort on the part of the worker, all that is necessary to proceed along the lines indicated. Since they are a universal language, employment of statistics in the interpretation of results of tests and measurements in physical medicine not only places such work on solid ground but also makes the results intelligible to other workers in the field and yields a common basis for comparison of similar work done elsewhere. The section which follows presents briefly those procedures of elementary statistics necessary to objective and valid interpretation of data.

Measures of central tendency represent either the performance of an individual on a series of repeated tests or that of a group on a single test. These measures include the mean (or average), the median and the mode, which serve as units for individual or group comparison. However, it must be remembered that none of these necessarily give a complete picture of performance. For example: one patient, in ten performances of a test, may have an average score of 20, whereas inspection of the individual test scores shows a wide range above and below that score. In comparison: a second patient, executing the same test under identical conditions, may achieve the same average score but the range of individual test scores is low, clustering around the average of 20. The interpretation would be that the second patient is steadier and less variable than the first. This difference in variability, not indicated by the measures of central tendency, is expressed by a measure of variability, which is necessary if an accurate and complete picture of performance is to be presented. There are several such statistical measures available. The one which is most indicative and more commonly used is the standard deviation, or sigma score, which gives the absolute variation within a single series of scores. When a comparison of variability in two or more series is desired, determination of the coefficient of variation is the statistical technic employed. The latter is especially useful in indicating the relative

variability of two tests when the scoring units of each are different. Through the use of these simple statistical tools — measures of central tendency and measures of variability — performance of an individual or group on a test may be expressed objectively and accurately in a language comprehensible to all.

It is often important to determine whether improvement, represented by increase in test scores during therapy, is sufficiently significant to warrant continuation of treatment. Likewise, it may be of clinical interest to compare the efficacy of two or more similar types of treatment and determine whether the difference in the resulting scores can be attributed to anything more than chance. The reliability of the difference between the means, another relatively simple procedure, can be used in such cases. It might be said that this statistical equation is one of the most useful for routine work in physical medicine. It is not difficult to apply and offers mathematical proof on which many decisions or claims can be based.

It has been stated that true validity and reliability of testing tools as well as the reliability of the operator are desirable. These may be established through a comparison of scores by means of correlation. Although this statistical procedure may seem formidable, the steps are simple and not difficult to master. If the purpose of the testing program is to establish the reliability and validity of a particular test or testing regimen, then it is almost impossible to avoid the use of correlation. The reliability of the difference between the means, may in some instances, be sufficient, but when precise validity and reliability are required, then the coefficient of correlation must be obtained.

It is not the intent of this paper to imply that the use of statistics alone will insure good testing and measurement and predicate comprehensive interpretation of data. Professional judgment, derived from training or experience or both, is necessary if a program of testing is to be adequate from its inception, with clarification of objectives, to its end, which must include interpretation of results. Professional knowledge points to clearcut and direct means of achieving desired ends; clinical experience indicates specific needs and is essential to legitimate interpretation. Judgment thus employed uses the tool of statistics to substantiate both theory and practice and to interpret and present results objectively in the light of clinical experience.

Procedures of physical medicine which make use of tests and measurements properly conceived and applied with intelligence, vision and understanding and followed by valid interpretation of resulting data will place this new specialty on a sound professional basis through improvement of service to the sick and the expansion of the frontiers of professional knowledge.

ELECTROMYOGRAPHY IN KINESIOLOGIC EVALUATIONS

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Improvement in the apparatus for the detection of electric potentials produced in muscles is responsible for the increasing use of this instrument in the diagnosis of injuries to the neuromuscular system. Several workers have reported on the use of this diagnostic aid in the determination of pathologic states, both traumatic and nontraumatic (Weddell, Feinstein and Pattle[1]; Hoefer[2]; Hoefer and Putman[3]; Hoefer and Guttman[4]; Watkins, Schwab and Brazier[5]; Brazier, Watkins and Michelsen[6]; Denny-Brown and Pennybacker[7]; Schwartz and Bouman[8]; Lindsley[9] and others). Electromyography has been employed by Scheib and Arienti[10] to determine the muscles involved in walking in the normal subject, and by Inman and associates[11] to note the action of muscles about the shoulder.

We thought it of value to investigate action potentials created by the contractions of individual muscles in normal subjects in order to determine their function. For this purpose a two channel ink-writing oscillograph employed for electroencephalography and modified by the substitution of heavier writing pens was found to be a satisfactory instrument, after guards were placed on the outside of the arms of the writing pens. These rubber guards restrained the wide excursions of the pens, as when large potentials were created by strong muscular contractions, and so prevented them from going over the edge of the recording paper strip. This modification caused some decrease of the maximum amplitude which could be recorded. This we found unimportant in our study.

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* Read at the Twenty-Fifth Annual Session of the American Congress of Physical Medicine, Minneapolis, Sept. 3, 1947.

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The ink-writing oscillograph, because of the mechanical inertia of the writing element, has a much more limited response to higher frequencies than a cathode ray oscillograph. The ink-writing oscillograph has the advantage that it produces cheaply an immediate and permanent record which can be observed during and after the investigation. When one considers that even in a limited and preliminary study, such as that on which this report is based, well over 5,000 records were made, this item of costs assumes considerable importance. The ink-writing instrument avoids the delay which accompanies the more complicated and more expensive photographic process.

In our work thus far we have studied only muscles which lie directly beneath the skin. We have employed the surface electrodes used for encephalography. These consist of circular metallic disks 1.2 cm. in diameter with a shallow central depression. We avoided the use of coaxial needle electrodes for several reasons. Surface electrodes were found to be satisfactory. Their application did not cause pain. We considered it objectionable to have a needle inserted into the belly of the muscle which was actively contracting. According to Brazier, Watkins and Michelsen,[6] the data secured by means of surface electrodes are essentially the same as those derived from needle electrodes.

While much data can be secured through the use of surface electrodes, they have their limitations. A minimum distance was required between the electrodes, probably because of the isoelectric points created in the field produced by the contracting muscle fibers. This distance varied in different persons and in different muscles in the same person. It was sometimes impossible to obtain action potentials from muscles which were obviously contracting, such as the small muscles of the hand, since one cannot easily isolate narrow muscles and be certain that some of the action potentials are not derived from adjacent muscles. The amplitude of the action potentials appeared to be dependent to some degree on the thickness of the tissue interposed between the muscle under observation and the skin surface. It would seem that only subcutaneous muscles can be satisfactorily investigated. If one electrode was on one muscle and the other electrode on another muscle, action currents were found when either muscle was contracted, and there appeared to be summation if both contracted simultaneously. If one electrode was placed on one muscle and the other on a neutral point, as the lobe of the ear, potentials produced by the interposed contracting muscle could be recorded.

As a general guide for placement of electrodes, we found it useful to determine the motor point by electrical stimulation of the muscle under observation and then to place each of the electrodes at an approximately equal distance away from this point, so that a line drawn between the two electrodes would be parallel to the muscle fibers. We found the usual minimum distance between the two electrodes to be approximately 2.5 cm.

In the past, kinesiologic evaluations have been made in various ways. Duchenne[12] applied electrical stimulation and observed the motions produced. Beaunis [13] and DeMeany[14] recorded human muscle action on myographs. Sherrington[15] stimulated cortical areas of animals and palpated the muscles for evidence of contraction. Tilney and Pike[16] stimulated the motor cortex of animals and recorded the muscular contractions by means of electromyographs. Performance of a given motion with or without visual or palpation

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evidence is the method employed in kinesiology today. This method is based on research in the past and appreciation of the involved anatomy.

Electromyograph in Motions of the Biceps Brachii

As an example of kinesiologic data which can be obtained through electromyography, we present the following condensed report of the findings secured from the biceps brachii in various motions of the upper extremity. Recordings were made during some 187 different motions performed by each of 5 normal subjects while standing erect and again, whenever possible, in

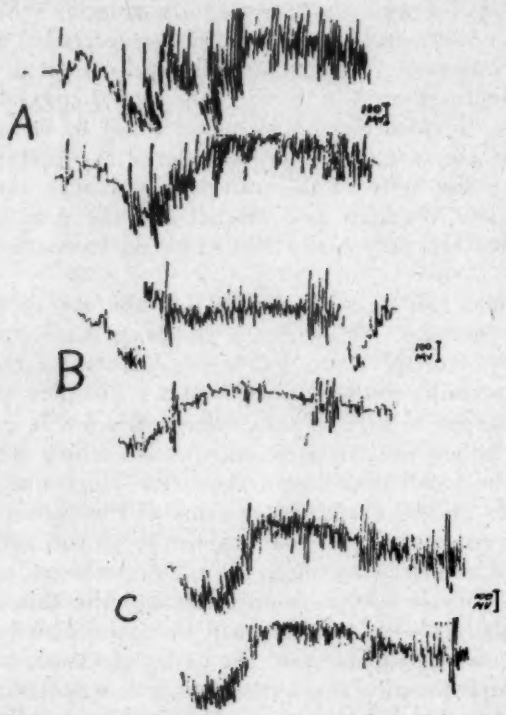

Fig. 1. — Forearm flexion in (*A*) supination, (*B*) pronation and (*C*) midposition; subject standing.

the supine position. These motions were also repeated with the use of 2 pound weights. In addition we took electromyographic records of the biceps muscle produced during motions performed by several other normal persons.

In Forearm Flexion and Extension. — The biceps acts as a flexor of the forearm when the forearm is held in supination, in pronation or in the midposition. Forearm flexion in supination causes approximately equal contraction of both the long and the short head. When the forearm is in the pronated or the midposition, the contractions of the two portions of the muscle are unequal, the short head occasionally failing to show any evidence of electric potentials.

With the subject supine and the forearm completely extended, flexion at the elbow initially produces a maximum potential, which gradually diminishes until it disappears when the forearm reaches an angle of 120 degrees. Continued flexion produces no further evidence of any potentials until the last few degrees of flexion, when the forearm and arm press against each other. These conditions are best observed when the motion is performed slowly and with resistance. The apparent absence of biceps contraction while the forearm is passing through a considerable portion of its arc of flexion (while the subject is in the supine position) cannot be explained as due to the influence

of gravity, inasmuch as the cessation of biceps activity becomes evident long before the angle of 90 degrees is reached. When one electrode is placed over

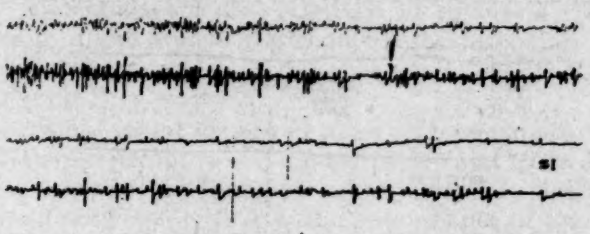

Fig. 2. — Biceps potentials (light curve, from long head; dark curve, from short head); the lower pair of curves is the continuation of the upper pair. Subject supine; slow forearm flexion. There is a gradual diminution of potentials, with disappearance at 120 degrees.

the biceps and another over the forearm flexors, action currents are recorded while the forearm is flexed to 90 degrees. Thus far we have not been able to identify the responsible muscle or muscle groups.

With the subject in the erect position, evidence of biceps contraction usually occurs during the entire period of forearm flexion and the amplitude

Fig. 3. — Same action as in figure 2 but performed more rapidly. Potentials reappear in extreme flexion.

of the potentials produced progressively increases as the flexion progresses.

In the initial phase of extension of the completely flexed forearm with the subject in the supine position, potentials can sometimes be secured from the biceps. This fact may be explained by the reasoning of Elftman, who has stated that in oscillatory movements, and otherwise generally, a muscle is

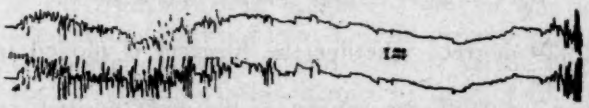

Fig. 4. — Forearm flexion; subject supine; electrodes on forearm flexors and biceps. Potentials are present until 90 degrees flexion and reappear in extreme flexion.

first stretched and then shortens. It is possible that the biceps first shortens in order to lengthen the triceps and thus initiate extension. A different explanation is offered by other workers, who have described a simultaneous contraction of antagonists. We have not observed this change in the biceps on all occasions of forearm extension. It is most likely to occur when the subject extends the forearm rapidly. Then there is a definite tendency to

Fig. 5. — Slow forearm extension; subject supine. Biceps potentials appear at angle of 120 degrees.

contract the biceps prior to forearm extension, especially when resistance is added and the subjct is in the supine position.

During rapid forearm extension with the subject in the erect position, no evidence of biceps activity is noted unless the motion is checked. In slow extension, potentials are observed. When the subject is in the supine position,

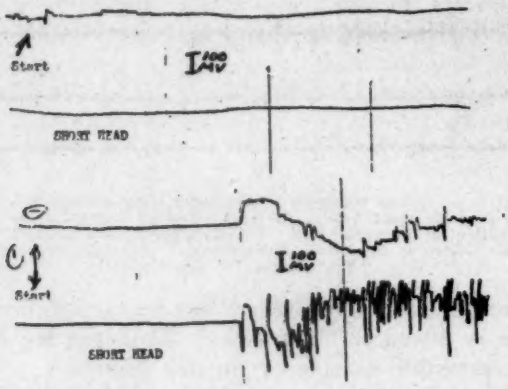

Fig. 6. — Upper curves, forearm supination in extension; lower curves, supination with forearm flexed and gravity eliminated.

slow extension of the forearm does not produce biceps potentials until the arc is reduced to about 120 degrees. These potentials gradually increase in size until complete extension is reached.

From a mechanical point of view it appears logical that the biceps should be required to exert its efforts during that portion of the arc of motion be-

Fig. 7. — Upper extremity abduction; forearm extended.

tween 180 and 120 degrees whether the forearm is moved in flexion or in extension.

In Supination. — With the subject in the erect position and the forearm extended, supination does not produce any evidence of biceps potentials if care is taken to prevent rotation of the arm at the shoulder. Biceps activity also appears to be absent when the extended forearm is supinated in other

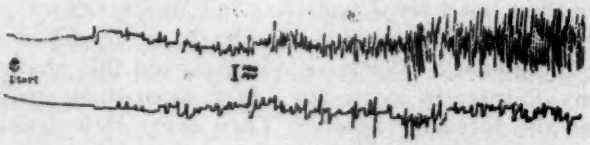

Fig. 8. — Upper extremity forward flexion; forearm extended.

positions, as in forward flexion, abduction or extension of the upper extremity if the static contraction of the biceps is eliminated, as by support. In our study, the addition of resistance did not alter these observations. Neither was there any electromyographic evidence of contraction of the biceps when supination was performed with the forearm flexed and supported until at the end of that motion, when its forced completion occurred. With resistance biceps activity appeared from the beginning of supination.

In Motions of the Shoulder Joint. — The biceps functions in movements of the shoulder joint. In abduction and foreward flexion, potentials become evident after these motions have been initiated. Resistance causes them to appear earlier. Potentials are also observed in extension. In maintaining the static position of the arm at the shoulder the biceps also plays a part.

Comment

Electromyography can be employed as an objective approach to the study of kinesiology. Its use permits a more quantitative and more detailed evaluation of muscular contractions than any other method to date. Electromyographic studies appear to show that in the performance of a motion a muscle does not contract unless it is required to do so, and then it contracts no more than necessary. When a motion is performed passively or with the aid of gravity, this conservation of energy becomes apparent. On the other hand, resistance causes it to work much harder. Evaluation of normal muscle actions by electromyography may well furnish a discriminatory guide for the application of therapeutic exercises and of occupational therapy. It can also serve as a basis of comparison with electromyographic observations in pathologic states of neuromptor systems.

Summary

Electromyography by means of surface electrodes and an ink-writing oscillograph is a good technic for the detection of the contractions of some muscles.

Muscles in action produce potentials, resting ones do not.

The position of the body, the speed with which a motion is performed and the degree of resistance influence the production of potentials in muscles.

A muscle crossing a joint takes part in the motion of that joint.

One muscle can be responsible for the initiation of a motion and another for its completion.

At the initiation of a movement, potentials can occur in the antagonists.

Evidence of the contraction of the biceps brachii was found when the forearm was flexed in all positions (supination, pronation and midposition). With the arm supported, potentials were evident at the beginning of forearm flexion in supination and continued until an agle of 120-100 degrees was reached, then disappeared and did not recur until at the end of the movement, when the flexion was forced. When this motion was reversed (the forearm going from complete flexion to complete extension), biceps muscle potentials likewise did not appear until an angle of about 120 degrees was reached.

Supination of the forearm did not produce any potentials in the biceps when the forearm was held extended. Neither was there any evidence of their presence when the forearm was flexed with gravity eliminated, until the very end of the motion.

Motions of the arm at the shoulder joint are accompanied with evidence of electric potentials in the biceps.

We desire to express our thanks to Miss Emily Nansen for her assistance in the translation of the literature written in the German and French languages.

The discussion of this article will be published in a later issue of the ARCHIVES.

THE PREVENTION OF POSTURAL DEFORMITIES IN CHILDREN WITH CEREBRAL PALSY

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Because of its complexity, it should not be expected that one drug, one type of brace, certain surgical procedures or a routine set of exercises can, alone or together, exert a spectacular response from the child with cerebral palsy.

The term "cerebral palsy" includes five primary classifications — spasticity, athetosis, ataxia, tremor and rigidity — each of which is a definite entity with predisposing etiologic factors and actual pathologic and physiologic differences. Under these five groups are several subclassifications which serve to designate further deviations. The true significance of these subclassifications remains to be seen. They have been recognized clinically and tentatively catalogued in hopes of precipitating more precise localization of brain damage which will effect a better understanding of the total problem.

For instance, in the spastic type of cerebral palsy alone great variance is found. The true spastic patient presents a predominance of spastic muscles with others which may be weak, normal or flaccid from cerebral origin. It is believed that in this type of spasticity the greater damage has been to Area 6 of the motor cortex, with the lesion extending to a lesser degree to Area 4, thus creating a spotty distribution of cerebral zero (flaccid) muscles. The weakness of the muscles is, presumably, the result of disuse, but it may be that there is also a pathologic type of weakness resulting from cerebral damage. It has been found that each of these muscle conditions has its own characteristics, and each lends itself to a particular type of muscle reeducation. Subclassifications of this group are atonic (aspastic) spasticity, indicating a predominance of cerebral zero muscles due to a greater damage to Area 4 of the motor cortex, and basilar spasticity, indicating a combination of spasticity with athetosis, due to a lesion in the internal capsule, where the pyramidal and extrapyramidal tracts are in close relation.

In the athetoid type there are at least eleven subclassifications. These are seen frequently, and each demonstrates consistently certain unique characteristics. Perhaps the most sharply defined of this group are the tension, the nontension, the pitch cut-off and the dystonic types of athetosis.

From this brief discussion it can easily be seen that there are marked deviations which must be recognized. By analogy, an automobile may be defined simply as a self-propelling vehicle, but upon investigation one recognizes multiple types of automobiles and multiple parts of each type which are neither identical nor interchangeable. Likewise, cerebral palsy may be defined simply as a lack of motor control, but, again, one must recognize the multiple variances in order to realize that one or two principles of treatment cannot be suited to every situation. As a mechanic must know and under-

stand the many parts of the many cars which come to him for repair, so the physician and technician must know and understand the many "parts" of cerebral palsy in order to guide an effective treatment program.

The prevention of postural deformities in children with cerebral palsy presupposes the need for a comprehensive treatment program which would include accurate diagnosis, and pattern or muscle analysis, followed by the necessary muscle reeducation, braces, apparatus, surgical procedures and medicaments, including drugs, accessory vitamins and minerals and an adequate diet.

Diagnosis

Since certain types of cerebral palsy are particularly prone to be followed by deformity, it is essential that an accurate diagnosis be made and preventive measures instituted early. The spastic type of child is most prone to the development of deformity because of the muscle imbalance which is present and because his muscle tendons do not grow as rapidly as the bones to which they are attached. There are several combinations of muscle imbalance which will contribute to subsequent deformity: (1) spastic vs. weak, (2) spastic vs. flaccid, (3) spastic vs. normal, (4) normal vs. weak, (5) normal vs. flaccid and (6) weak vs. flaccid.

The patients with rigidity are the next most susceptible to deformity. In true rigidity there is a lack of contractility and a plastic tone, which may assume either a flexor or extensor posture and gradually become a fixed posture. In the intermittent type of rigidity, the intensity and frequency of the recurring rigidity are a predetermining factor as regards potential deformity. For instance, a strong unilateral pull of the adductor group with a concommittant pull of the abductors and lateral abdominal muscles on the opposite side results, momentarily, in a marked pelvic obliquity and spinal deviation. If these rigid states occur frequently enough and severely enough, this reaction can result ultimately in a dislocation of the one hip with a compensatory shortening of the opposite quadratus muscle and a true scoliosis. When the rigidities favor any of the flexor groups, there is a similar propensity to deformity.

In the athetoid group, the patients with the "tension" type of athetosis are the most apt to acquire deformity as a result of prolonged postural attitudes plus the tension which favors certain muscle groups. An athetoid patient who has tension in the knee flexors and calf muscles will, through sitting all day and then sleeping with the knees bent and the feet down, eventually acquire actual fixed deformity from shortening in these muscle groups. Persons with other types of athetosis who are without tension and have freedom of joint motion are less likely to need preventive measures.

Patients with tremor show little or no tendency to deformity because of the balanced, reciprocal motion between opposing muscle groups but may profit by braces for control. Those with ataxia, as a group, demonstrate relaxed ligaments and hypermobility which is most noticeable on weight bearing. Both of these groups may, however, show deformities such as short heel cords from lack of weight bearing.

Muscle Analysis and Reeducation

After the diagnosis is established, an accurate muscle analysis should be made to determine the existing imbalance about a joint. An intelligent selection of the spastic, normal, tight, weak and flaccid muscles is the foundation of sound muscle reeducation technics. An understanding of involuntary motion, tension, incoordination, overflow and balance loss is also essential. Therefore, muscle analysis and diagnosis together will indicate the preventive or

corrective measures necessary in the presence of potential or actual deformity.

Braces and Apparatus

Braces for the child with cerebral palsy differ considerably from the bracing used in infantile paralysis. In the latter, the problem is largely one of weakness, for which supportive apparatus made of relatively light materials are used. Although there are some types of patients with cerebral palsy (those with atonic spasticity) for whom this kind of bracing would be adequate, the vast majority require an entirely different type of brace, which will control muscle strength rather than muscle weakness. Therefore, braces for these children must be constructed of materials capable of controlling excessive strength, with particular adaptations at the hip joints to withstand the lateral stresses arising from involuntary motion and tension, as well as at the ankle joints in order to control the equinus thrust which is found in so many cerebral palsied children.

In considering the use of braces for the lower extremity from a preventive or corrective point of view, the commonest deviations of each joint and the probable relationship of one joint picture to another must be kept in mind.

Hips —
1. Flexion tightness or tendency
2. Internal rotation tightness
3. Adductor tightness
4. Abduction and external rotation of one leg with adduction and internal rotation of the other leg

Knees —
1. Flexion deformity
2. Hyperextension

Ankles —
1. Equinovarus
2. Equinovalgus
3. Calcaneovarus
4. Calcaneovalgus

It is not often that any one of these clinical pictures will occur without associated problems in adjacent joints. For instance, tightness of the hamstrings develops naturally with the flexed hip position and vice versa. In the deformity with external rotation of abductors with internal rotation of adductors there is a similar tendency toward hip and knee flexor tightness; and with primary adductor tightness there seems to follow a tightness of internal rotators and flexors as well. Thus, in planning bracing it is necessary to consider all factors involved and, if necessary, err in bracing too extensively rather than insufficiently. It is easier and less expensive to reduce the amount of bracing gradually than to increase it.

To correct hip and knee flexor tightness, long leg braces with pelvic band, hip and knee locks and right angle stops at the ankles can be very effective. If the plantar flexors at the ankles are tight as well, an adjustment at the ankle stop to allow for gradually increased dorsiflexion is necessary.

A spreader bar attached to a pair of long leg braces just above the knees is effective in stretching out the tight adductors. This spreader bar is adjustable and can be lengthened as improvement occurs, thereby increasing the range of abduction at the hips.

When there is abduction and external rotation of one leg with adduction and internal rotation of the other, long leg braces with an S strap (extending from the outer side of one thigh cuff, under that leg and over the thigh cuff of the other leg to attach at its outer side) cause a correction or overcorrection of the rotator distortion. An elastic strap extending diagonally from the inner side of the thigh cuff of the adducted leg to the inner bar at the ankle of the other leg causes the adducted leg to be pulled down and the abducted

leg to be pulled up, thereby helping to level the pelvis and to correct the obliquity.

An equinus deformity may result from a tight gastrocnemius muscle, a tight soleus muscle or both. Before bracing can be determined, it is necessary to know which is the offender. If dorsiflexion is blocked with the knees extended, the gastrocnemius is responsible, since it has its origin above the knee. If motion is blocked with the knee flexed, the soleus is at fault. In order to stretch the gastrocnemius adequately, the braces should be long calipers with locks at the knees and adjustments at the ankle joints to allow for periodic increases in dorsiflexion. If the soleus alone is responsible for the tightness, a short, single round bar caliper will be sufficient; this, too, is to be bent periodically, gradually stretching the foot into the corrected position.

Bracing for the upper extremity is not usually so extensive. A commonly found condition is tightness in the wrist or finger flexors. Deformity here can be prevented by applying splints by night which maintain the wrist and fingers in extension, in conjunction with short hand splints by day which do not interfere with finger use.

Braces which are used to prevent or correct deformity must be applied with extreme care. The feet must be bathed daily. Socks must fit perfectly and be without ridges or darning. The shoe should be applied without the brace, with the knee bent, to be sure that the heel is well down; it should be laced snugly, especially about the ankle to hold the foot down into the shoe. This is important for two reasons: 1. If the heel is not down and the shoe lace is loose, the involuntary motions of the foot will cause the heel to rub against the shoe and form pressure sores. 2. If the heel is not down, there can be no true correction in the braces. When there is a back brace or pelvic band, it is better to have no underclothing between the brace and the skin of the child. Leather is skin, and there is less friction between two skin-covered surfaces. The braces should be checked frequently to see that they fit properly. Reddened areas on the skin indicate pressure areas, and these should be investigated and the cause corrected immediately. "Pull-over" straps at the knees should be applied if there is any tendency for the knee to come into contact with one of the brace bars.

With properly fitted and properly applied braces, the child can learn to tolerate them for extended periods, and eventually they can be worn throughout the night as well as during the day.

A program which will encourage good postural habits over extended periods is essential. One of the most valuable pieces of apparatus for this is the standing table. With the child maintained in good alinement with braces, he can spend two or three hours a day in the standing table, building up muscle strength, tone and tolerance to braces. A carry-over to night braces thus assures good preventive measures against deformity. Likewise, his sitting balance should be as well supervised and controlled. A special chair, built to specific measurements of the child, giving support wherever necessary, should be made. The angle between the seat and back should, wherever possible, conform to the angle of a normal chair.

Surgery

Although there is a definite place for surgery in cerebral palsy, it is limited in its scope. Operations on the extremities are contraindicated for athetoid patients, though bone stabilizations have been successful when previous use of an external fixation has shown no unfavorable athetoid shift.

Certain operative procedures, such as neurectomies, tenotomies and bone stabilizations, are of proved value in the true spastic patients. The problem

in such cases is to evaluate accurately the muscle balance about the joint before a surgical procedure is determined. Not infrequently it has been found that correction of one deformity has created another. The best example of this is operation on the heel cord to correct an equinus deformity, with a resultant heel-walking deformity. Obviously, the presence of spasticity in the dorsiflexors of the foot and ankle was unrecognized. With a weakening of the calf muscles by lengthening of the heel cord, the dorsiflexors of the foot and ankle become relatively more powerful and reverse the imbalance.

A conservative attitude towards surgical treatment of these children should be taken. Trial bracing should be done, and only after careful evaluation of the joint muscle imbalance and the results of the use of braces, should operation be contemplated. The use of braces should be continued after operation and through the growth period to prevent the recurrence of deformity.

Drugs

Certain drugs are used in selected cases of cerebral palsy. These include drugs for sedation, for control of seizures, for the postencephalitic states and the so-called relaxant drugs. It is the latter group with which we are interested in this article, for a drug which induces muscular relaxation would necessarily reduce any tendency to the development of contracture or deformity. In this group are included prostigmine and curare.

Experience with prostigmine has led us to believe that it is most beneficial in management of the rigidities and tension athetosis. Since release in a spastic patient would allow more stretch reflexes to occur, thus causing more constrained motion, its benefit to that group is questionable. Physiologically, there seems to be no reason for it to be of any value to the patients with tremor or ataxia.

Curare is available as Intercostrin, a purified extract, and beta-dehydroerythroidin, a synthetic preparation. Curare is a paralytic drug which must be employed with discretion and under close supervision. Personal experience with this drug in an intensive study of its effects on several different types of cerebral palsy at the State Hospital for Crippled Children, Elizabethtown, Pa., was disappointing.

Diet and Vitamins

A great many children with cerebral palsy present serious feeding problems because of their difficulties with chewing and swallowing. Hence it is very important that a strict meal routine be observed which will allow adequate time for feeding. An impatient, hurried attitude on the part of the feeder reflects itself upon the child, upsets him emotionally and thereby deprives him of the full benefit of the food which he needs. A sensible, well planned diet should include proteins, minerals and energy-giving foods with supplementary fluids during the day.

It must be remembered that the food intake of a child with the athetoid type of cerebral palsy should be greater than that of children with the other types because of the tremendous exhaustion of energy by involuntary motions. Because the children with spastic paralysis are more placid and sedentary, their energy output is such that they do not require more than the average diet.

It has been found feasible to incorporate vitamin therapy into the general treatment program of these children. The members of the B complex are the most likely to be insufficient, and, in addition to the specific effects of the components of the complex, a generous intake helps to stimulate appetite and to reduce constipation.

Vitamin B_6 in conjunction with vitamin E is used for flabbiness and muscle weakness. It is advisable that administration of vitamins A and D should be maintained throughout the year for the first five or six years of life.

Conclusion

Careful use of these treatment technics alone is not enough. Just as the complexity of cerebral palsy necessitates the careful integration of a number of technics, so, too, it necessitates the total cooperation and understanding of all persons who handle the child. Any one member of the treatment staff cannot fully use his skill and methods unless other members work with him in a total program. Likewise, a perfectly functioning treatment staff cannot achieve its goal without the cooperation of the parents, the family unit and all the people who work and play with the child with cerebral palsy.

OXYGEN THERAPY IN POLIOMYELITIS

A Tracheotomy Inhalator Incorporating Humidification and the Optional Use of Positive Pressure for Oxygen Therapy in Patients with Tracheotomy *

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Seventy-three patients with acute poliomyelitis with involvement of the vital bulbar nuclei were admitted to the University of Minnesota Hospitals during the 1946 epidemic. For patients presenting demonstrable or impeding laryngeal paralysis a therapeutic regimen was evolved to guarantee patency of the upper airway, combat pulmonary edema and provide oxygen-enriched mixtures in the tracheal inspired air.[1] An apparatus which would accomplish the last two objectives was constructed during the epidemic. This apparatus, termed an inhalator, was designed to humidify the oxygen-helium (or oxygen-air) mixtures administered via tracheotomy under optional positive pressure. The inhalator was so constructed that expiratory and inspiratory positive pressures could be controlled independently as emergency demanded. A detailed description of the inhalator, which may be constructed and assembled in a few hours, is reported for the convenience of physicians confronted with similar problems in future epidemics. The significance of features incorporated in the tracheotomy inhalator which differ in certain respects with some-

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* Aided by a grant from the National Foundation for Infantile Paralysis.
* This study was made possible by the cooperation of the Minnesota Poliomyelitis Research Commission.
1. Minnesota Poliomyelitis Research Commission: Poliomyelitis: I. Bulbar Poliomyelitis; A Neurophysical Interpretation of the Clinical and Pathological Findings, to be published, J. Neurol. & Men. Dis. The Bulbar Form of Poliomyelitis: I. Diagnosis and the Correlation of Clinical with Physiologcal and Pathological Manifestations, J. A. M. A., to be published.

what similar devices described by Barach[2] and by Glaser[3] is discussed. A brief summary of the experience with the inhalator in the treatment of patients with bulbar involvement during the epidemic is reported.

Construction and Assembly of the Tracheotomy Inhalator

All but a single component of this apparatus is available from stock laboratory supplies and hospital oxygen therapy equipment. The fitting by which the tracheotomy tube is attached to the inhalator, called the T-I attachment, may be constructed by a machinist. The inhalator consists essentially of five parts (fig. 1):

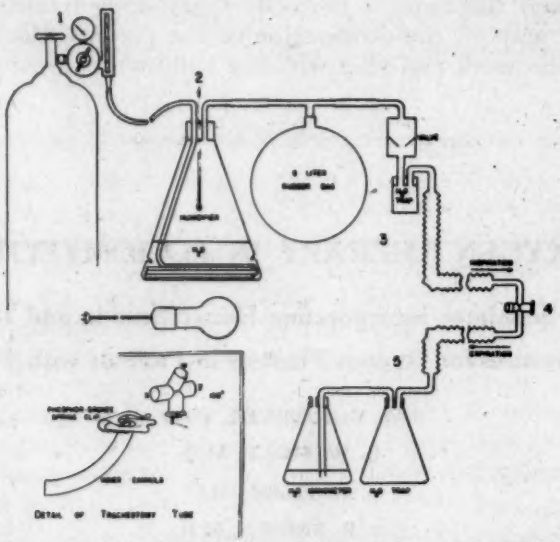

Fig. 1. — Schematic diagrams of the inhalator and modified tracheotomy tube.

(1) cylinders of oxygen and helium or compressed air with flow meters; (2) a humidifier; (3) an inspiratory system with breathing reservoir bag, flap valve and condensation trap; (4) a tracheotomy tube-inhalator attachment (T-I attachment) (fig. 2), and (5) an expiratory system with water trap and positive pressure manometer.

For the source of inhalation mixtures, the following combinations may be used: (*a*) a single cylinder of 80 per cent helium and 20 per cent oxygen; (*b*) a cylinder of 80 per cent helium and 20 per cent oxygen and a cylinder of 100 per cent oxygen with the respective flow rates of these two gases adjusted to a ratio to give the final concentration of oxygen desired, and (*c*) a cylinder of compressed air and a cylinder of 100 per cent oxygen adjusted as in (*b*).

The humidifier consists of a 3 liter Erlenmeyer flask and 3 feet of rubber tubing (1/4 by 1/16 inch) perforated with a triangular surgical needle at 1/4 inch intervals in that portion of the rubber tube immersed in water. In order to maintain this rubber tubing below the surface of the water, indentations in the wall of the flesk are made by forcing a metal rod into a heated area of the flask. The water in the humidifier is heated to 35 C. by a 60 watt light bulb placed under the flask provided with a thermometer. The humidified inhalation mixture is then collected in a 3 liter rubber bag, which acts as a breathing reservoir. A one-way "duck-bill" flap valve is inserted into the inspiratory system between the breathing bag and a condensation trap;

2. Barach, A. L.: Principles and Practices of Inhalational Therapy, Philaedlphia, J. B. Lippincott Company, 1944, p. 279.
3. Glaser, D. F.: Tracheotomy in Bulbar Poliomyelitis, J. Pediat. 27:560, 1945.

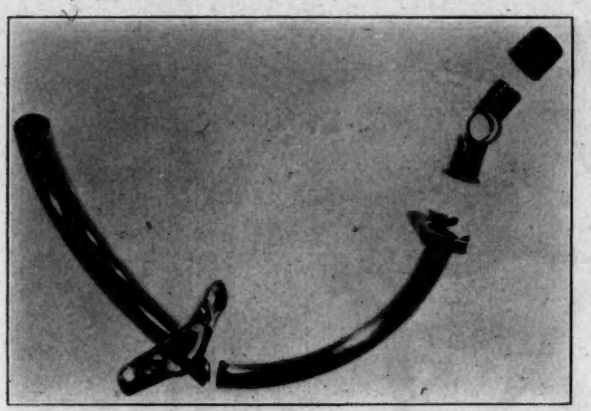

Fig. 2. — Photograph illustrating the relative position of components of the modified tracheotomy tube.

the latter prevents water entering the tracheotomy tube. The expiratory system consists of a positive pressure manometer and another trap which is provided to collect condensation water from the patient's expired air and also to prevent water entering the tracheotomy tube from the positive pressure manometer flask in the event of a sudden violent inspiration. The positive pressure manometer consists of a glass tube immersed an adjustable distance below the surface of the water in an Erlenmeyer flask which is open to the atmosphere. All tubing in the system distal to the breathing bag should be of as large bore and as short length as possible to minimize resistance to the flow of gas. Tubing of 3/4 inch diameter may be used expect in the short section involved in the T-I attachment. It is recommended that glass or transparent plastic be used for all the stationary parts of the system for convenient visualization. This is advantageous in inspecting the inhalator during use and is also useful in training personnel in its use. The inhalator should be arranged in relation to the patient so that both condensation traps are dependent to afferent and efferent tubing for proper drainage of condensation water (fig. 3).

A fitting by which the inhalator could be conveniently attached to standard silver Chevalier Jackson tracheotomy tubes was designed (figs. 1 and 2). This T-I attachment is held in place by a U-shaped phosphor-bronze spring clip which is soldered to the inner tracheotomy tube. This type of tracheotomy tube attachment is essentially a four-way tube constructed somewhat in the shape of a cross. The inferior outlet of this four-way tube is fitted directly over the superior end of the inner tracheotomy tube and is held in place by the spring clip which fits over a projection on the lower margin of the T-I attachment. The lateral outlets are connected to the inspiratory and expiratory tubes of the inhalator, and the superior outlet is provided to facilitate suction of the tracheotomy by catheter without interrupting the use of the inhalator. Except for the brief intervals when the trachea requires suction for the removal of mucous, this superior outlet is occluded by the insertion of a rubber stopper. Care should be taken to see that this stopper is of such size and shape that it cannot slip into the T-I attachment far enough to cause any obstruction to the other outlets. A rubber vaccine bottle stopper is therefore useful in this regard. In patients with a tracheotomy who are in respirators,[4] the superior outlet on the T-I attachment is preferably inclined 30 degrees from the vertical position cephalad to facilitate accessibility for suction of the tracheotomy tube.

4. The modifications undertaken to provide adequate clearance of the tracheotomy when the patient is in a respirator will be reported by Holt and co-workers.

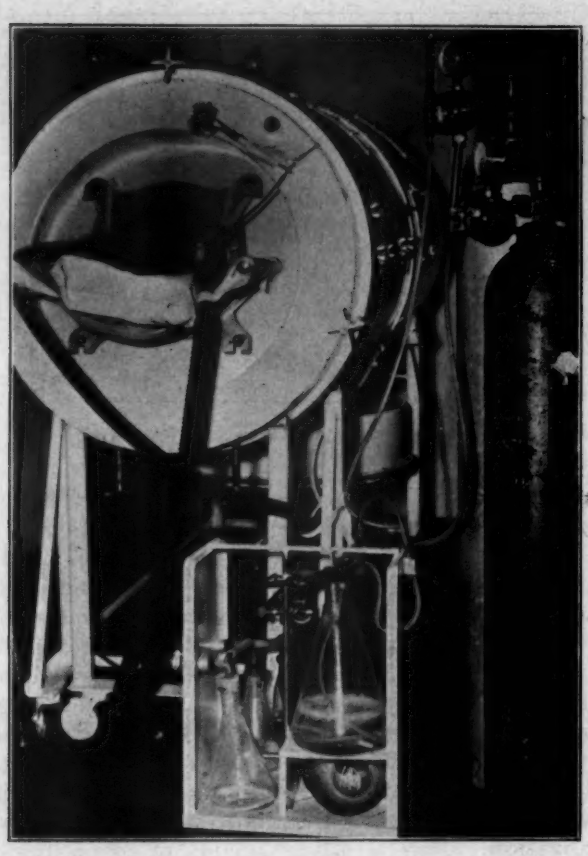

Fig. 3. — Photograph of the tracheotomy inhalator connected to a bulbar poliomyelitis patient in a respirator.

Recommended Routine for Use of the Tracheotomy Inhalator

In setting up this apparatus for use on the tracheotomy patient, water is put into the humidifier flask to a level of 4 to 5 cm. above the perforated rubber tubing. The light bulb under the humidifier flask is turned on and the temperature of the vapor regulated to 35 C. by adjustment of the distance between the bulb and the flask. Patency of the inspiratory system may be checked by manually occluding the end of the inspiritory system at the point where it is to be fitted to the tracheotomy inhalator attachment. Starting the flow of gas through the humidifier will then inflate the breathing bag. Release of the end of the inspiratory tube allows part of this volume of gas to pass through the one-way flap valve. The expiratory system may then be checked for patency by approximating the open ends of the inspiratory and expiratory tubes (circumventing for the moment the T-I attachment). Flow of gas should then occur through the entire unit as indicated by continuous bubbling of gas from the positive pressure manometer under water. All fittings in the inhalator should be checked for leaks. The inhalator parts may be autoclaved or treated with 1:1000 zephiran chloride solution. The T-I attachment is to be sterilized along with the tracheotomy tube prior to the operative procedure.

The inhalator may now be used for oxygen therapy in a patient with tracheotomy (fig. 4). After the T-I attachment is clamped in place on the inner cannula of the tracheotomy apparatus, the three remaining outlets are left open until the flow of the desired oxygen mixture has filled the breathing

bag. The inspiratory tube is then connected to one of the lateral outlets of the T-I attachment and the expiratory tube to the other. Finally, the superior outlet is occluded. This sequence prevents embarrassing of inspiration

Fig. 4 — Photograph of the tracheotomy inhalator connected to a bulbar poliomyelitis patient without spinal involvement.

until an adequate flow of gas is available through the inhalator. The total flow rate of the oxygen mixture should be adjusted so that the breathing bag is fully inflated during expiration and not less than three-fourths inflated during inspiration. A rate of 6 liters per minute for adults and 3 to 4 liters per minute for children is usually satisfactory. If at any time the breathing bag is being deflated excessively during inspiration, the rubber stopper in the superior outlet of the T-I attachment should be removed at once while the rate of flow of gas through the inhalator is being adjusted. During these adjustments embarrassment of inspiration may be prevented by occluding temporarily the superior outlet of the T-I attachment with the finger, which is quickly removed if the breathing bag continues to show excessive deflation during inspiration. This rubber stopper should be removed whenever it becomes necessary to discontinue the flow of gas through the inhalator, as in the changing of gas cylinders or in the event of any difficulty in operation of the inhalator. The temperature of the vapor in the humidifier should never be allowed to exceed 35 C., since this causes excessive condensation in the inspiratory system. The necessity of arranging the condensation traps dependent to the tubing in the inhalator and leading to the patient cannot be overemphasized. The entire system should be checked for condensed water every four hours if heat is applied to the humidifier and every twelve hours if the humidifier is operated at room temperature.

Inspection of Inhalator in Operation for Adequacy of the Patient's Respiratory Excursions and for the Detection of Obstruction

The inhalator should be inspected frequently to ascertain whether it is operating satisfactorily. The breathing bag is observed to undergo volume changes with each tidal exchange, being partially deflated during inspiration and fully inflated during expiration if the flow rate of gas is properly adjusted, since during the latter phase of respiration the one-way flap valve is closed. This excursion of the breathing bag should not proceed to a point of less than three-fourths full inflation. If this excursion of the breathing bag is not occurring, there is an obstruction in either the inhalator or the tracheotomy tube, the flow rate of gas through the inhalator is excessive or the patient is breathing through his upper airway.

Intermittency of the bubbling of the patient's expired air through the positive pressure manometer under water on the expiratory system affords another criterion that the inhalator is operating properly. While this estimation is in no way quantitative, the amount of gas emitted by way of the manometer and the duration of this bubbling is useful, particularly in patients with apnea, a serious symptom in poliomyelitis.

For application of these criteria, it is frequently necessary to occlude the upper airway above the tracheotomy by holding the nose and mouth closed. This prevents whatever upward leak is occurring around the outside of the tracheotomy tube, thus avoiding dilution of the gas administered through the inhalator with air via the upper airway. If this leak has been appreciable and the excursions of the breathing bag have not been apparent, this procedure should cause such excursions to appear in the breathing bag. Similarly, occluding the upper airway (by mask or manually) should cause bubbling in the positive pressure manometer during expiration.

If the excursion of the breathing bag and the intermittent bubbling of expired air through the water above the positive pressure manometer do not occur when the nose and mouth are occluded, an obstruction in the trachea or the tracheotomy tube must be ruled out. Following suction of the tracheotomy, failure of the breathing bag excursions to occur and continuous bubbling through the manometer implies an obstruction in the trachea or bronchi. Nurses are instructed to apply suction only to the tracheotomy tube; a bronchoscopist should therefore be called. He has the choice of removing the mucous accumulations which are usually the source of the obstruction by passing the catheter into the trachea and bronchi or aspiration under direct observation by bronchoscopy. Thus by the proper use of the inhalator, the physician may determine the indication for suction of the tracheobronchial tree below the level of the tracheotomy.

Use of the Inhalator for Oxygen Therapy Without Positive Pressure

Oximetry may be employed to determine not only the patient's requirement for oxygen therapy but more specifically whether such oxygen should be administered under positive pressure.[5] If such studies indicate that positive pressure is not necessary and oxygen therapy alone maintains a satisfactory arterial oxygen saturation, the tracheotomy inhalator is used with the positive pressure manometer submerged below the surface of the water only 1 or 2 cm. This adjustment is recommended to preserve the feature of convenient visualization of the patient's expired air through the manometer and applies a negligible positive pressure against expiration. For all practical purposes, the use of the inhalator in this way does not exert therapeutically effective positive pressure.

The use of 80 per cent helium and 20 per cent oxygen at a flow rate of 3.75 liters per minute combined with 100 per cent oxygen at a flow rate of 2.75 liters per minute has been satisfactory in the routine use of the inhalator. This adjustment provides a 50 per cent oxygen concentration in the inhalation mixture. However, in patients with marked hypoxia, 100 per cent oxygen administered by inhalator and supplemental mask was used for limited intervals.

The absolute arterial oxygen saturation of patients being treated with a 50 per cent oxygen mixture by inhalator was checked frequently by Van Slyke manometric analysis for oxygen content and capacity. In the majority (77 per cent) of these patients, it was found that the routine use of 50 per cent oxygen by inhalator without any procedures to prevent dilution with

5. Elam, J. O.; Hemingway, A.; Gullickson, G., and Visscher, M. B.: The Impairment of Pulmonary Function in Poliomyelitis, to be published.

air inhaled through the nasopharynx resulted in arterial oxygen saturations of 90 to 96 per cent. Attempts to improve oxygenation were undertaken when the arterial saturation fell below normal as determined by oximetry or chemical analysis. Supplemental oxygen by mask or nasal catheter was administered to prevent or reduce the dilution of the inhalation mixture caused by inspiration of air through the nasopharynx, and in selected cases the use of positive pressure was necessary for this purpose. However, the hypoxia in patients with extensive hemorrhagic pulmonary edema or atelectasis defied even these measures to provide proper oxygenation. Oximetry provides a clinical test for evaluating the success of oxygen therapy.[5]

The Use of the Tracheotomy Inhalator for Positive Pressure

Since pulmonary complications involving an interference with gaseous exchange in the alveoli are seen frequently in bulbar patients with serious involvement of the vital centers,[1] the inhalator is provided with simple mechanisms for the use of positive pressure. The depth of the positive pressure manometer in water determines and indicates the expiratory positive pressure applied. In the presence of impending or existent pulmonary edema, the use of pressures from 4 to 12 cm. of water have been used, depending upon the degree of oxygen deficiency. However, positive pressures exceeding 2 cm. of water are to be used with extreme caution in poliomyelitis because of the frequency of reduced ventilatory function due to involvement of the diaphragm and intercostal muscles or depression of the respiratory center. Therefore, the use of pressures which are well tolerated in other diseases may seriously embarrass the respiration and circulation of these patients. The previously recommended positive pressures should be used only with careful and constant observation. If ventilation is being supported by artificial respiration methods which provide external pressure to the thorax and abdomen during expiration, positive pressure therapy may be undertaken with greater assurance. Precautions must be taken to prevent the dissipation of the positive pressure through the nasopharynx; this may be accomplished by the use of a mask which effectively closes the upper airway. By this use of the inhalator, some of the patients who did show gross pulmonary edema rapidly improved.[5]

Sudden episodes of pulmonary edema were associated with the accumulation of excessive secretions in the trachea. In patients developing sudden cyanosis, pulmonary edema froth was observed welling through the nose and mouth or was evident when tracheotomy suction was applied. In one patient who presented these symptoms (C.S.U.),[5] 75 cc. of frothy edema fluid was obtained by suction of the tracheotomy and upper trachea. Rales were audible throughout the pulmonary fields. A positive pressure of 12 cc. of water during inspiration and expiration was employed for thirty minutes in this patient. Resorption of the edema fluid was evident by the disappearance of rales and cyanosis. During the time the positive pressure of 12 cm. of water was used, expiration was augmented by means of a modified Bragg-Paul pulsator.[6] For the remainder of this patient's course in the hospital, artificial respiration was necessary, and a positive pressure of 4 cm. of water on expiration was used. An oximeter study, in which the arterial saturation with oxygen under this pressure was compared with that when oxygen was given by mask alone, is to be reported elsewhere.[5] Oximetry showed that to maintain this patient's saturation at an optimal value, oxygen by mask in addition to that administered under positive pressure by the inhalator was required.

6. (*a*) Drinker, C. E.: Pulmonary Edema and Inflammation, Cambridge, Mass., Harvard Univ. Press, 1945. (*b*) Medical Research Council: Report of the Respirators (Poliomyelitis) Committee. "Breathing Machines" and Their Use in Treatment, His Majesty's Stationery Office, London, 1939.

The inhalator may also be used to apply positive pressure during inspiration by a maneuver similar to the common practice in anesthesia of manual compression of the reservoir breathing bag. In addition to compressing the breathing bag during inspiration, it is necessary to occlude the upper airway; otherwise, the increase in positive pressure is dissipated and not applied to the pulmonary alveoli. During expiration, the breathing bag is allowed to reinflate and the upper airway is patent. By means of oximetry, the results of increasing the inspiratory positive pressure without opposing expiration were determined in several patients.[5]

Comment

Of the 73 adult patients with bulbar poliomyelitis, admitted to the University of Minnesota Hospitals, 39 were treated by tracheotomy for partial or complete obstruction of the airway.[7] It was necessary to use a mechanical respirator on 21 of the 39 patients because of failure of the central or peripheral respiratory mechanism.

The tracheal secretions were thick and viscid and tended to obstruct the airway after tracheotomy. This problem was especially important in patients with weakness of the diaphragm and intercostal muscles superimposed upon their bulbar disease. The tracheotomy patient was deprived of the physiologic humidification of the inspired air by the nasal mucosa. In addition, gas as supplied in high pressure chambers was excessively drying to the tracheobronchial tree. The tracheotomy inhalator apparatus described was evolved to meet these difficulties, in addition to its primary purpose of delivering oxygen to the tracheotomized patient. Even greater humidification, when required, was attained by nebulizing saline or penicillin solution directly into the tracheotomy tube. This procedure was possible without interrupting oxygen therapy; the nebulizer was attached to the superior outlet of the T-I attachment.

Continuous use of the inhalator varied from four days as a minimum to a maximal period of four weeks. The easily visualized excursions of the breathing bag and intermittent bubbling of the expired air through the manometer facilitated the following of critical patients. By careful observation of these criteria, the special nurse could call the physician to determine the source of any difficulty; during a large epidemic, such adjuncts are very useful. The tracheotomy inhalator is not to be considered in any way a device for artificial respiration.

The rationale of the use of helium in airway obstruction has been presented by Barach,[8] Dean[9] and others. The effectiveness of expiratory positive pressure in the treatment and control of pulmonary edema has been established by many studies.[10] However, it should be emphasized that expiratory positive pressure therapy should be attempted only with extreme caution and constant supervision in the poliomyelitis case due to the impaired ventilation mechanism.

The device described by Barach[2] for positive pressure oxygen therapy by means of tracheotomy does not provide for humidification or means of independently increasing inspiratory positive pressure. Glaser[3] has described

7. Priest, R. E.; Boies, L. R., and Goltz, N. F.: Tracheotomy in Bulbar Poliomyelitis, Ann. Otol., Rhinol. & Laryng. 56:250, 1947.
8. Barach, A. L., and Eckman, M.: Use of Helium in the Treatment of Asthma and Obstructive Lesions, Ann. Int. Med. 9:739, 1936.
9. Dean, R. B., and Visscher, M. B.: Kinetics of Lung Ventilation, Am. J. Physiol. 134:109, 1939.
10. Barach, A. L.; Martin, J., and Eckman, M.: Positive Pressure Respiration and Its Application to the Treatment of Acute Pulmonary Edema, Ann Int. Med. 12:754, 1938. Barach, A. L., and Swenson, Paul: Effect of Breathing Gases Under Positive Pressure on the Lumens of Small and Medium-Sized Bronchi, Arch. Int. Med. 63:946, 1939. Carr, D. T., and Essex, H. E.: Certain Effects of Positive Pressure Respiration on the Circulation and Respiratory Systems, Am. Heart J. 31:53, 1946. Carlisle, J. M.: Pulmonary Edema, J. A. M. A. 123:947, 1943. Gagge, A. P.; Allen, S. C., and Marberger, J. P.: Pressure Breathing, J. Aviation Med. 16:2, 1945. Poulton, E. P.: Left Sided Heart Failure Treated with Pulmonary Plus Pressure Machine, Journal-Lancet 21-983, 1936. Drinker-6a.

an interesting apparatus designed primarily to remove accumulated secretions from the posterior part of the pharynx, but no provision is made for humidification of inspired gases or for control of inspiratory and expiratory pressures.

Summary

The construction and operation of a tracheotomy inhalator is presented. This apparatus provides humidification of the inspired air and has simple arrangements for the optional use of positive pressure during expiration and for increasing the positive pressure on inspiration as an emergency maneuver. Its use in 39 poliomyelitis patients with involvement of the vital nuclei of the brain stem is reported.

This work was greatly facilitated by the splendid cooperation of the United States Army Air Forces in supplying vital materials and equipment under emergency conditions. We also wish to acknowledge the indispensable assistance of Mr. W. L. Adams, Miss Donna Jeanne Laker, Miss Mildred Olson, Mr. E. A. Greene and Mr. L. C. Gambol in the construction of the apparatus and of Mrs. J. F. Smersh in technical work.

PHYSICAL MEDICINE REHABILITATION IN A VETERANS ADMINISTRATION MEDICAL AND SURGICAL HOSPITAL*

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The introduction of modern physical medicine, with its third phase of medicine, into the Veterans Administration Hospitals is one of the greatest advances in the treatment of our patients since the beginning of the Veterans Administration. It is not sufficient for the medical or surgical personnel to guide their patients through the acute stages of their malaise or injuries, but their convalescence must be also carefully planned through skillful guidance and shortened in every way possible. We in the Veterans Administration have a great responsibility to our patients, as civilian hospitals and clinics, insurance companies and the armed services are our direct competitors in the field of Physical Medicine Rehabilitation. These agencies have either established or are establishing centers for the modern care of the injured and disabled. The Veterans Administration Physical Medicine Rehabilitation Service must play a leading role in this all-over program in order that our standards remain second to none.

Lessons taught the medical profession by Dr. George Deaver, at the Institute for the Crippled and Disabled in New York, should stand out as an inspiration to each and every one of us working in Physical Medicine Rehabilitation to resolve that no task is impossible to surmount or overcome.

A great many medical personnel, in their eagerness to treat the injuries or the residuals of pathologic processes, neglect to treat the patient as a whole individual. Their surgical or medical skill may be beyond reproach, yet it never occurs to them to question subjective symptoms even and after anatomic recovery appears to be complete. Worse still, they unwittingly lend

* Published with permission of the Chief Medical Director, Department of Medicine and Surgery, Veterans Administration, who assumes no responsibility for the opinions expressed or conclusions drawn by the author.

* Read at the Western Section of the American Congress of Physical Medicine, Los Angeles, January 22, 1948.

themselves to production of a functional state by careless remarks in the presence of a patient or his friends. Furthermore, any physician or surgeon who thinks he can ignore psychology as an agent of healing is passing up one of the most potent forces at his disposal.

Medical rehabilitation is the application of good psychosomatic medicine by the employment of physical, psychologic and vocational methods. The physiatrists or other physical medicine rehabilitation personnel do not have to be psychiatrists to render their services, but the psychiatric approach to rehabilitation by the consultation services by a competent and qualified physiatrist is extremely valuable. Each case should be carefully and completely studied in order to understand the character or personality of the patient so as better to evaluate the patient's emotional problems, as physical injury may excite psychoneurotic reactions. Likewise, psychologic problems in the return to employment necessitate carefully controlled guidance and training and often recreational and exercise therapy, as well as educational therapy and/or vocational advice.

In conducting a program of physical medicine rehabilitation, the services of properly trained and qualified technical personnel are of paramount importance. These personnel must be carefully screened and placed in the type of work they are best suited to carry forth. All personnel, likewise, should be encouraged to do research for developing better and newer methods and report on it before weekly departmental seminars. Regular class periods also should be scheduled for keeping all personnel abreast of modern biophysics and physical measures, research and publications. All rehabilitation personnel must be teachers to increase their patient's interest, not merely mechanical stereotype workmen. Gone are the days when the glorified chambermaid or the self-trained nurse could become a physical therapist, when the physical educational personnel were merely "muscle men," instead of counselors, and the occupational therapists were glorified weavers. All personnel now are anxiously working with and training the patient to improve him physically, mentally, psychologically, morally and vocationally and, finally, to bring about resocialization.

At this time let us look toward the economics involved in a physical medicine rehabilitation program. In the past, the patient merely returned home for an indefinite rest period, during which he was to recuperate as best he could and return to his job whenever he felt that he was physically able to do so. Workmen or state compensation payments for nonemployment were consequently costly, and both the employer and the employee suffered considerable losses varying from financial bankruptcy to the lack of supplying the dependents with the essentials for a good life. Furthermore, the economic burden on the community was increased, as hospitals in the past found it necessary to allot many beds for the paraplegic and hemiplegic patients and others who were placed to bed to die or were considered hopeless and beyond repair.

Physical medicine rehabilitation has for its prime interest the reduction of this economical loss and, likewise, adjustment of the social problems confronting the patient who in the past was faced with a prolonged period of convalescence. The importance of the convalescent phase of any disease cannot be overstressed, as the physician's responsibility must not cease with the diagnosis or treatment of a disease process or injury. When a man becomes a physician, he assumes a greater responsibility to the individual and to the society in which he practices. His concern for the patient should start at the beginning of the disability and end only and when recovery is complete

and the patient is restored to usefulness by alteration of his disability or completely removing it.

The objects of rehabilitation are several fold, namely: A physical mental, social and vocational readjustment, so that industry will welcome the disabled person to their factories and jobs. Industry is thus really the keystone in the whole structure for the needs of rehabilitation, as the biproducts of labor are what we all strive to produce. Labor and employer must understand that rehabilitation, the third phase of medicine, is a service and right they all should enjoy when injured, as the patient will return not as a half man but as a full man as far as his work is concerned. The training given him during his convalescence has prepared him to do his job better than usual and with a lower accident rate than the average individual. Likewise, physical medicine rehabilitation service must be made available to all citizens in a democracy, and they have a right to expect such opportunities or training to cure or reduce their disability so they may return to the same job or be trained for an alternate job.

The success of any rehabilitation program depends upon close and unified cooperation on the part of all of the personnel concerned. Close liaison must be maintained between all the services concerned, especially the personnel of the rehabilitation units. No less important is the need of a happy atmosphere and pleasant surroundings in the rehabilitation center. The earlier any disabled persons or any hospital patient is able to receive the benefits of physical measures for starting his rehabilitation program, the more quickly he will be returned to his duties. Physical medicine has thus proved to be an all-important and necessary adjunct in the rehabilitation and treatment of the injured or ill. Its department must be adequately manned by a competent physiatrist and qualified therapists, and thus it becomes an integral part of the hospital. The department should be centralized so that it is made more easily available to all departments. The physiatrist should direct the activities, and, besides having knowledge of biophysics, he should have a good sound knowledge of general medicine and the art and science of the application of physical medicine. He should prescribe all the treatments for the patients, including the rehabilitation prescriptions, and these prescriptions should be ever so minutely outlined.

It is further important that the physiatrist assume full responsibility for the administration and application of all of the activities in the physical medicine department. Every patient is an individual problem and should be analyzed, studied and treated as such. There should never be a stereotyped treatment or technic prescribed, as the individual should be treated a a whole, and not only from the standpoint of his pathologic lesions. The old system of having any physician order the type of physical treatments that strikes his fancy is mentioned only to condemn it, as the practice of physical medicine is not only a specialty but a definite application of skill and knowledge which the physiatrist must possess if he is fully competent to deal with the indications and contraindications to the various modalities. Equally as important as the application of properly prescribed and controlled physical therapy is the application of occupational therapy in the treatment of our patients. Actually, occupational therapy is applied work therapy through a medical prescription, and thus its program must be carefully worked in combination with physical therapy or as an adjunct to physical therapy. Each unit should be acquainted with the common problems and the needs of each case, and thus it is desirable to have the patients housed in a common unit and under the same physician-supervisor. Every patient thus referred for physical measures or rehabilitation is given the benefit of the combination therapy

and the same careful consideration by the personnel in the two units, as the individual is trained as such and not as a group case for a pathologic state. The Council of Physical Medicine divides occupational therapy into: (1) preventive or diversional therapy, (2) functional therapy, (3) prevocational therapy and (4) recreational therapy, which is really a subdivision of preventive therapy.

The importance of this classification is that the word therapy is used in all classes, and it is equally important for us also to stress the word medicine with the use of these terms, as we are actually correcting pathologic states or injured parts by the application of mechanical apparatus, just as we correct these conditions by chemotherapy or physical agents.

To guard against fatigue, the patient is cautioned that exercise, whether work or play, should consist first of relatively short periods. It is recognized that fatigue may be mental as well as physical. Therefore recreational therapy is an important adjunct to the proper functioning of this program. Recreational therapy, which may be a form of either occupational or corrective therapy, can be arranged to give desired exercises, through the placing of special equipment in a recreational room in conjunction with the physical medicine department. In this department, there should be a pool table, and a table for table tennis; these provide walking exercises, exercise of the hand and arm and general coordination through recreational activities. In addition, a room should be made available for playing floor checkers for back exercise and for eversion and inversion of the ankle, as well as wall checkers and dart games for shoulder, arm and hand action. Table hockey is useful for supination, pronation and general coordination, and many smaller games, such as blocks, peg-pounding and various shuffle boards, are valuable for movements of the hand and fingers. Besides these, there should be whenever possible, an outdoor shuffle court, tennis and badminton court, swimming pool and archery court, as well as horseshoe pits which are to be used for shoulder, arm and general body exercise. These forms of recreational therapy should be under the direction of the chief of corrective therapy and his therapists, but much of the outdoor recreational facilities could be shared with other department needs. Another function of the recreational room is its contribution to the much needed social adjustment of the patient, as recreation gives mental relaxation after the workshop or physical program.

During rehabilitation of an injured man, one may spend a long period of time training him vocationally or physically, but if he is unable to achieve his proper position under social conditions he will never become really rehabilitated. In rehabilitation there is an ever-increasing use for, and encouraging results from, active-resistive exercises. Among the younger patients who can stand the strain and many of the older patients, we have elicited much enthusiasm and cooperation from having the patient work usually against the operator's resistance (concentric force) or the operators working against the patient's resistance (eccentric force), and there results after a time an appreciable increase in the size and strength of the atrophied muscles as well as normal muscles. These muscle groups and joints are first worked in unison under the supervision of the physical and corrective therapists, and later gentle stretching or manipulation helps break down firmer adhesions of the skin to connective tissue and muscles or adhesions to traumatized muscles and tendons to bone. Joint stiffness is actually due to lack of exercise plus the gluing reaction of edema, rather than immobilization, as the lack of exercise produces capsular and intraumuscular adhesions. Failure to exercise the body as a whole also results in an increase of body weight and a loss of general muscle tone and substance. It is a good rule in case of treatment for

pathologic changes, such as joint stiffness, to precede the exercise therapy by applications of some form of heat and gentle massage and, when indicated, by petrissage and friction. Excitement of the pain reflex or muscle spasm must be avoided at all times, but the employment of a certain amount of fatigue which clears before the next treatment is beneficial. The relaxation of the opposing muscles by the patient is the crux to good results in passive exercise, as is graduated resistance in active exercise. Remedial exercises, whether active or passive, are used to combat disease and disuse muscular atrophy, in order to reestablish or establish a balance between antagonistic muscle groups (in both of which the weakened muscles are exercised actively and their opponents relaxed reciprocally), to overcome limitation of joint motion in which stretching of the shortened or contracted muscles is encouraged by use of gravity — that is, the body weight — and, finally, to correct habitual abnormalities of posture and gait, or those secondary to injury or disease in which normality is achieved by the repetition of corrective exercise.

The final step necessary to medical rehabilitation is the employment of the industrial conditioned reflex. This is brought about by use of educational therapy and manual arts therapy, which really is employment on a minor scale of the curative workshop and thus implies the use of both guidance and treatments. These processes tend to cause reflex stimuli to work together and thus establish a pattern which is stronger than working alone. Deliberate action becomes an effort of willpower or thought, but for deliberate muscle action to be developed into state of skill muscle action a period of training or education is necessary, requiring concentrated mental effort and practice, and this can only lead to desired skilled action as experience is obtained. Such skilled actions will develop more rapidly under the Veterans Administration Educational Therapy Division. These personnel working in complete unison with each other and the other members of the rehabilitation team and in direct cooperation with Vocational Advisement and Social Service Sections of the hospital and regional office, is the final answer or step for the proper rebuilding of our veterans back to useful and completely individual citizens.

Naturally, certain problems must be worked out with all the services concerned in order to have the program of physical medicine rehabilitation function properly. Each person concerned should be properly indoctrinated with the basic principles and needs for the utilization of the third phase of medical care.

In conclusion, I wish to state that it is my sincere hope and ambition to see that this program functions in all our hospitals, as it is essential that we treat our patients completely and properly so that they will be proud of our hospitals and that their employers will be able to say "thumbs up" to the disabled.

ROUND TABLE DISCUSSION ON BIOPHYSICS

A portion of the General Scientific Session of the American Congress of Physical Medicine on Sept. 5, 1947, was devoted to a round table discussion on biophysics. Taking part in the discussion were Marvin M. D. Williams, Ph.D. (by invitation), Department of Biophysics, Mayo Clinic, Rochester, Minn.; Kurt S. Lion, D.Eng., Associate Professor of Applied Biophysics (by invitation), Massachusetts Institute of Technology, Cambridge, Mass.; Julia F. Herrick, B.A., M.A., Ph.D. (by invitation), Associate Professor of Experimental Medicine, Mayo Foundation, Rochester, Minn., and Howard A. Carter, M.E., Secretary, Council on Physical Medicine of the American Medical Association, Chicago. The moderator was Dr. Frank H. Krusen, Professor of Physical Medicine, Mayo Foundation and the University of Minnesota, Head of the Section on Physical Medicine, Mayo Clinic, Rochester, Minn.

DR. KRUSEN: I have a set of questions which have been submitted. In order that we may act promptly, if any of you have any questions you would like to ask, write them on a piece of paper and bring them forward and place them in front of me at any time during the discussion itself, or, if you will pass them forward on a piece of paper and place them here, I will try to get to as many as possible.

The first question, as we have arranged them, is: What is biophysics? I am going to take the liberty of assigning questions, and if I don't assign them properly, I shall ask you to suggest some other one. Dr. Herrick, will you take No. 1?

DR. JULIA HERRICK: Biophysics is the application of the principles of physics to biology in its broadest sense. To date, biophysics has consisted largely in bringing the tools of the physics laboratory to the biology laboratory, whether that be physiology, general biology, radiology, or physical medicine, or to any place where you might want something measured.

The main function of the physicist in working cooperatively with you, since he is limited in his knowledge of the problems in your field, is to measure accurately for you; and, as you know, the most important step toward a complete understanding of any research investigation is measurement. We cannot compare one observation with another until we have a common yardstick, and it is in that measurement that the physicist functions primarily.

Biophysics, unfortunately, to date, has not brought much "meat" to the field of pure physics. It has not developed to the extent that biochemistry has, where one finds new chemical reactions within the living organism that are as fascinating to the pure chemist as to the biologist. Those phenomena that the biophysicist has observed have not been received so enthusiastically by the pure physicist. We hope that they will become more interested in the future.

DR. KRUSEN: Thank you, Dr. Herrick. I think that starts us out very well.

There is a problem that has concerned all of us in physical medicine which comes to us in this discussion in various ways. A question has just been brought to me on the subject matter of a course in biophysics in the medical curriculum. The next question on our list received previously perhaps would clarify that question and develop it more satisfactorily. The question is: What would be the major divisions of a course in biophysics for medical students? I should like to ask Dr. Williams to give us his comments on this question.

DR. WILLIAMS: I think that the divisions of a course in biophysics for medical students would at the present time depend considerably upon the person giving the course. To give a course which would be rather ideal would probably be difficult because there are very few, if any, physicists, biophysicists or physiologists who are capable of covering the field as it should be covered.

Of course, I would name first the field in which I have for many years been most closely associated, the field of radiology. I think a certain amount of radiology should be included in the course, a discussion of some of the electrical principles behind x-ray equipment and the production of radiation. Of course, with the production of roentgen rays, the production of ultraviolet radiation and visible light, the production of infra-red rays and the production of diathermy waves, short waves and so on, there is a certain similarity in the radiations and also in the methods of production.

Then, along with the production of radiation, immediately you come to what is probably more important — in the field of medicine at least — the absorption of the radiation because no effect can be produced by radiation unless it is absorbed. There again I would tend to emphasize the x-rays, gamma rays and the whole range of rays. In my lectures to the radiologists I compare the absorption of that type of radiation with the processes of absorption of the ultraviolet, the visible and the infra-red radiation in particular. And so I should say that at least you

would have to include a considerable amount of discussion on radiation in general which would cover the entire range of radiations.

In order to understand very much about the absorption processes and the production of radiation, it is necessary to know a considerable amount about the structure of the atom and the structure of molecules, because the absorption of radiation is an atomic process. A certain amount of knowledge of atoms and atomic structure is necessary.

That, of course, leads directly to the field of radioactivity, which is part of the atomic structure, and that would lead, of course, into the application of the isotopes in tracer work and therapeutic work, which is so much in the foreground at the present time.

Then, of course, biophysics for medical students would have to include something on sound with relation to hearing and light with relation to sight, and probably a few other physical phenomena which have to do with the special senses.

Then there is a very large field of biophysics, but I don't know where it should be included. It would have to be worked out with other departments. For example, modern physiology is to a very considerable extent also biophysics in the broad sense of the word. The two fields cannot be sharply divided, I think, any more than the fields of chemistry and physics can be divided. So that course would have to be worked out with other departments in order to give a well rounded course and not too much overlapping.

Along this line, Dr. Krusen, I should like to raise an objection to the implication of this question. Personally I feel that a course in biophysics does not at the present time belong in a medical course. I believe that it should be a premedical course. That brings up problems of curriculums — whether it can be included as a premedical course, and so forth. Biophysics as we know it today and as far as it has gone today might better be taught as a premedical course. That is being done in one institution that I know of, Queens University in Canada, where two years of physics is a prerequisite for medical students. The first year of physics includes what is ordinarily given in a first year physics course, with the exception that electricity and magnetism are omitted. During the second year, they start with electricity and magnetism and continue for the largest part of the year with a course which is primarily biophysics. It is taught by Professor Robertson, and the textbook he uses is a book he has written called "Radiologic Physics." The title is a little bit misleading, although he does probably discuss the problems of physics as they apply to radiology more than the other fields; yet he discusses diathermy and many of the problems that the physiatrist is interested in. The book he has written does not cover the entire course. It is a course in biophysics and I believe it is probably one of the best places for the course. As I say, that would have to be worked out by the school. Being a physicist, I believe that premedical students should have more physics than they do have.

DR. KRUSEN: This leads up to another point with regard to physics and the teaching of physics. Medical educators and deans of medical schools (and I speak with some recollection, having been an associate dean of a medical school for ten years), have been conscious that often the physics taught in premedical schools was a course given for engineering students and not specifically directed toward medical education or having the applications which were needed in medicine.

The Baruch Committee on Physical Medicine felt that the investigation of this whole problem of the teaching of biophysics was so important that they appointed a special subcommittee under Dr. Francis Schmitt (and I am sorry he is not here), which went to the American Physical Society, and that Society, on a subsidizing grant from the Baruch Committee, appointed a special committee which has for a period of two years been investigating the problem of teaching physics to medical students. I hope that they will have a report soon.

Dr. Lion, being associated with Dr. Schmitt, may be able to give us information about that.

One point I should like to make. I think it was the consensus of the Subcommittee on Research of the Baruch Committee — Dr. Ivy, Dr. Bronk, Dr. John Fulton, and others — that physics should be taught in the premedical course and that the teaching of biophysics should be added to the curriculum in the preclinical years of medical school and the clinical application in physical medicine should be developed in the clinical years.

Dr. Lion, will you comment on this investigation?

DR. LION: I am not quite informed what the last report of the Committee on Education in Physics is, but I can say this much: physics has been attacked quite frequently. It has been said that it is an engineering science. It has been stated it needs a great deal of mathematics and is, to make it short, boring for a student in medicine. He is in the preclinical years and he wants to become a doctor. He has a preconceived notion of what he wants to

do. He does not see where physics belongs to it. There are two possibilities: Either the physics instructor has a special interest in medicine and, in making clear why physics is important, changes the course, or the physics instructor gives a straight physics course.

I am in favor of the latter possibility because I do not think that it helps essentially to make a good physics course if you constantly say to a student, "It is very important for you," whether it is important for him or not. That is something which he will feel by himself. It is necessary that a physics course, in order to be appealing to a student in medicine, must be good, and you can only specify what kind of material is to be covered and not that the course should be good.

That, of course, leads up to the question, What kind of material is to be covered in such a course? Again, if I may be permitted to give my own opinion, I would say straight, honest-to-goodness physics without application — without engineering application and without medical application — because physics is the science that takes a natural process and explains it in a very generalized way by the help of very few and very intelligently chosen magnitudes and by the help of very few and very general rules. You can only mix up and make these things more difficult if you teach them as an engineering science or teach them as a medical science.

Let me give you an example. If you have the thermodynamic system, then it has a certain pressure, a certain volume, a certain temperature and something which we call a certain gas constant. If you increase the pressure or decrease the volume, then you get the pumping action. That can be expressed very nicely if you draw a square on the blackboard like this and draw a piston in here; if you exert a force here, you decrease the volume and increase the pressure — that is fine, clear and understandable. Now, try to tell the doctor that this fact is very important for an understanding of the motion of the heart; put a heart in here, with its different chambers, and you will not be able to determine at what point the pressure goes up and the volume goes down. You mix up the splendid, clear thinking process that is involved in a system as simple as that [referring to illustration of square].

It is not true that the examples in physics are chosen from the engineering point of view because physics is an engineering science. No, these examples have been chosen because they are very simple and very fundamental. Take a cantilever and say that if this is the point that it rotates around, you exert the force here and it has a certain relationship between these forces and momentums.

That is simple and clear. Try to tell the student in medicine that this [flexing arm] is the same system and you will get into trouble because it isn't the same system. It rolls here and shifts the point [illustrating elbow]. If you would like to give a thorough understanding of what physics is, stay away from any application and give a good physics course without any mention, or if you are interested enough, with only occasional mention of the medical applications.

Dr. Krusen: I think that clarifies our thinking on this problem a great deal.

The next question that we have: Can a course in biophysics be taught to students ignorant of trigonometry and analytical geometry? Mr. Carter, will you comment on that question?

Mr. Carter: I had hoped you would pick somebody else for that. Coming back to the courses in physics in universities: They are usually in charge of physicists, and many physicists have an engineering leaning. It is only natural for them to think in those terms. Therefore, the courses have been largely directed toward engineering sciences or applied physics. That is the way I found it when I was teaching physics. Now since I have been associated with the physicians for several years, I see that that plan is wrong for premedical students. In my opinion, there should be courses in physics which will apply to principals in medicine.

I think it is impossible to teach much in physics without using mathematics or using geometry. That is, I don't believe that one is going to understand physics completely without using the tool of mathematics. It helps one to think. One uses mathematics as one uses building blocks, if you please. Mathematical symbols become an assortment of building blocks in helping one to understand the physical laws. The mathematical formula is the most accurate method known to state a physical law.

Dr. Krusen: Thank you, Mr. Carter. Perhaps there is some other opinion with regard to it. Dr. Herrick, would you care to comment more fully as to your reaction on this opinion.

Dr. Herrick: Yes. I feel very definitely allergic to this idea of trying to make physics easy. You wouldn't want to have physics made easy. You really enjoy doing the difficult things. There is no thrill about doing something in a very easy way. Of course, you want to do it in the simplest way possible. There is no reason why a teacher of physics should not make the subject clear. If a physics teacher un-

derstands thoroughly what he is teaching, he can make it clear.

DR. KRUSEN: Without the use of mathematics?

DR. HERRICK: Why do you wish to have physics as a part of your research? There is, in my opinion, only one main reason: because you want to measure. Now if you want to measure, how can you measure without mathematics? I think perhaps you develop a mental attitude toward the subject of mathematics. It is really one of the finest, well, I recommend it very highly as a hobby for almost any doctor of medicine. In fact, I heard Dr. Condon, who is the President of the American Physical Society and Director of the Bureau of Standards, say that the engineer uses more difficult mathematics than he thinks he is using. If he realized the difficult mathematics he was using, it might be a stumbling block to him.

Trigonometry is one of the simplest types of mathematics [laughter]. After you have made your measurements, you want to get a relationship between these measurements. You express it in terms of symbols. Don't call it mathematics if you are allergic to the term. Make it a sort of game. Now, after you have made all these measurements and you have made them carefully and objectively, you wish to study them. As soon as we can get all these measurements in a state in which things will be objective there will no longer be personal opinions, and when personal opinions are eliminated arguments are reduced to a minimum.

So, in order to analyze these data that you have collected, you have to understand the relationships; and the relationships are in themselves mathematical. When you arrive at that point, you will find yourself enjoying mathematics instead of being annoyed and bored with it.

DR. KRUSEN: I think that is one of the interesting problems that comes up here: We as clinicians in physical medicine realize our own intense ignorance of mathematics and physics — most of us — and we realize that the students with whom we work are most of them distinctly deficient in mathematics and physics. We realize the importance of these subjects in medicine and we wonder how to do the impossible. How can we teach biophysics and physical medicine to physicians with these deficiencies? How can we solve this problem?

DR. LION: Dr. Krusen, I think, answered his own question. Can biophysics be taken without knowledge of trigonometry and mathematics? Yes. If the man takes the course and if the course is any good, after a very short time he will come to the use of mathematical expressions entirely by himself. I don't think that anybody who went through our course (and it is not a particularly good course yet — it will be one day), is capable of solving differential or integral equations. But I remember a student who took our course, who is in this room now. After four weeks he came up and mentioned a problem that he would like to integrate during his work here and that he could use an integrating network of this and that kind. That is one day I enjoyed my life!

DR. KRUSEN: Most of you know that Dr. Lion has been running a series of fifteen week courses for young physicians or old physicians who are interested in biophysics.

DR. LION: There are no "old" physicians in my course! [Laughter.]

MR. CARTER: Will some one tell us where arithmetic ends and mathematics begins? I believe that will help us in the discussion.

DR. HERRICK: Arithmetic is mathematics.

DR. LION: I think that should be excluded from this discussion.

DR. KRUSEN: It is interesting to find that questions coming up are very similar to questions previously received. Here is one that has just come to my hand: Are courses in physics or biophysics for graduate physicians of value without laboratory practice? How long would a course be then?

Here is the question coming up next on our list. Would it be safe to give a course in biophysics without laboratory work? You can see the similarity of the two questions.

DR. HERRICK: I think that a course in biophysics without laboratory work is about as valuable as a course in medicine without a patient.

DR. KRUSEN: That answers that emphatically.

The next question: How can one make the subject appeal to the medical student? Do we have a volunteer on that, Dr. Williams?

DR. WILLIAMS: I wouldn't try to make it appeal. I might sort of continue a little bit of the discussion on the previous question here. I feel very strongly about it, and I think it is an important one. I don't agree with all that has been said by some of the other experts up here. They have a right to have a difference of opinion.

Personally, I don't feel that physics can be taught without mathematics. I don't think that biophysics can be taught without a background of physics. Biophysics is a second course. You have physics first, then biophysics, that is, the application of physics to biology.

In fact, some twenty years ago, when I was teaching physics in college and had

no intention of having any interest at all in biology — I never had a course in biology until I was a graduate student — I felt that a physics course in college for the premedical student should be different from that given for the pre-engineering student. I felt that way for a good many years, but the longer I have been associated with the medical profession, the more thoroughly I am convinced that, if anything, I would reverse the procedure now. I certainly would not give a special course for premedical students trying to choose applications from biology. If anything, for the course for pre-engineering students I might try to choose as many biological applications as possible, and for the premedical student as many engineering applications as possible. I actually wouldn't go that far, but my tendency would be that way. In this day of specialization, I think it might be worth while to try to teach the engineers a little bit of biology and the medical men a little bit of engineering.

Fundamentally, I don't believe physics can be taught as anything but physics. You have to learn the fundamental physics first and you can't learn very much in fundamental physics without a certain amount of mathematics, and after you have learned physics, then you may be able to apply it to biology.

I don't see any particular way of making it attractive to the premedical student. I will admit the majority of physics teachers do not present the subject in an interesting way to anyone. I think the courses could be made much more interesting, but it is the method of presentation and the enthusiasm of the instructor for teaching his course and not the effort to apply it which the student goes for. After all, if the students had their way, there are a great many subjects which they would not take which are prerequisite for medicine.

My attitude toward a discussion of this type is that we are talking about what should be done for the future student. That doesn't necessarily apply to you who have finished school: To give a course for graduate medical men at the present time is one problem; whereas, to give a course for premedical students that would be the ideal thing in their training is a different matter. In a postgraduate course we have to take into account what training the men have had and we have to teach accordingly. But if they have had the training which some of us think they should have had previously, the postgraduate training as far as biophysics is concerned could be greatly curtailed as it is given now and we could go ahead with much more important things and get more rapid development than we can at the present time, when we have to spend most of our available time trying to teach the postgraduate medical student the simple things in electricity and magnetism which he should have had at his finger tips and which he has forgotten — largely, I think, because of the failure in our modern type of education.

DR. KRUSEN: To tie this together, we can make the categorical statement that physics is of growing importance in medicine. We see the physicist groping toward the clinician on the one hand, and I have been fascinated as I have watched the teaching and research programs in our medical schools to see the clinician who practiced purely, empirically, the field of physical medicine, groping toward biophysics.

First, as the centers developed, the clinician came with an interest in physics as applied to medicine. Then into the centers came the physiologists. The physiologists were interested particularly in the biophysical applications. Then as I watched these various centers grow, I saw the clinician and the physiologist seek the aid of the physicist. For example, at the Medical College of Virginia we saw Dr. Hellebrandt and Dr. Fischer pull in their biophysicists. Dr. Eichna at our conference last year had developed his program and said, "Where can I find a physicist?" As our program developed in our own center at the Mayo Foundation, immediately we turned to our physicists, Dr. Herrick and Dr. Williams, for guidance and advice. So we see in these developing programs the combined thinking of the clinician, the physiologist and the physicist, and we will have biochemists and others in the picture as we go along.

It is interesting to see this groping toward a common point and the need for a better understanding of physics as applied to medicine.

The next question: What instrumentation would be necessary in a medical course in biophysics? Dr. Lion, you are the instrumentation expert. Is that question possible of answer?

DR. LION: I don't think that I fully agree — excuse me if I say so — with the point of view of Dr. Herrick as far as biophysics is concerned. There is one direction of physics which is called instrumentation which is purely, I might say, an engineering science given to the laboratory physicist or laboratory physiologist or research worker. There is a second field — and I think Dr. Herrick will agree — that is real biophysics and has nothing to do with instrumentation.

Just to mention it — and I think you mentioned something of that kind — radiation physics at the point where it goes into genetics and quantum mechanics has

nothing to do with instrumentation. I might say it is theoretical biophysics. As far as the instrumentation aspect is concerned, I do not think that instrumentation is necessary for a physician who does not do research work. If he does research work, then he would need instrumentation. It is very difficult now to make a statement as to what he should learn. I should think instrumentation would be desirable, but, in general, the physiologist is more instrumentation-minded than the physicist and he knows very well what he needs for his own purpose.

DR. KRUSEN: Thank you, Dr. Lion. Dr. Williams?

DR. WILLIAMS: I will agree in a sense and maybe disagree with Dr. Lion. For an undergraduate course for the premedical student in biophysics, I believe a certain amount of laboratory work is extremely desirable. In a postgraduate course for medical men, I think its desirability depends very much on what the aim of the course is. I think Dr. Lion agrees with that.

DR. HERRICK: My remarks on instrumentation have to do with the introductory courses. One does arrive at the theoretical aspects after one has been thoroughly trained in the fundamental, introductory courses. We cannot use theoretical physics until we know more about the physical constants of biologic material. It is true enough that we have to apply theory, but I don't think that we can go entirely into theoretical work until we can measure some of these things.

There are two types of theoretical aspects. One is the theoretical treatment entirely of data that have been accumulated previously; the other is an anticipation, entirely theoretical, independent of any previous data.

DR. KRUSEN: Thank you, Dr. Herrick. This question comes to the table: How can one have laboratory work without instruments?

DR. HERRICK: That is the philosopher's way of doing it.

DR. LION: I have seen schools where apparently the laboratory work has to be done with practically no instruments.

DR. KRUSEN: Would the subject of levers be included in biophysics?

MR. CARTER: In my opinion, yes, it should be, because it can be applied to the muscular structure of the body. I think that the course should include something about the various types of levers.

DR. KRUSEN: Would biophysics include the study of orthopedics and posture — that is, the mechanics of posture and artificial limbs?

MR. CARTER: The answer is yes.

DR. KRUSEN: Would a course in biophysics in medical school assist in the preparation of a student for work with x-rays, ultraviolet radiation and radium?

DR. LION: Biophysics would necessarily deal with radiation and would include these topics.

DR. KRUSEN: Thank you. How does diathermy heat tissues? Dr. Herrick?

DR. HERRICK: I think Dr. Paul would like to answer that question! According to Dr. Lion's lecture, electricity does two things. It heats and it brings about chemical effects. What is the fundamental principle of heating? The principle fundamental to heating electrically is to send the current through a given impedance in the broad sense and if you are using direct current this impedance becomes the resistance.

There would be no heating if diathermy did not meet impedance. All electrical energy is dissipated ultimately in the form of heat, we might say. I would say heating a patient by diathermy is still not completely understood. Of course, a patient represents an effective resistance, or in other words, an impedance to the diathermy. Sometimes he is entirely part of a circuit and other times he is in the radiation field. If he is in the radiation field, he is a semiconductor and the lines of force as Dr. Lion explained to you yesterday, are changed due to the presence of the patient in the field. The impedance is changed and there is a change of electrical energy, but I will not go into the details of why. I can't explain it clearly because it is not clear to me.

MR. CARTER: Mr. Chairman, I should like to stick my neck out and inquire whether you would ask all those who understand the meaning of the word "impedance" to raise their hands.

DR. KRUSEN: All those who understand the word "impedance" raise their hands. [Several hands were raised.]

DR. LION: This is such a good opportunity to repeat a story which I heard in a lecture room about how electricity creates heat!

We think of the arrangement of a large ballroom where there is a little music and the couples are standing around here and there, irregularly distributed. If they should move, that would correspond to some temperature; the faster they move, the higher would be the temperature, but you don't see any reason for the increase of temperature. Now there are twenty bellboys at one end of the ballroom; the bell captain whistles, whereupon an electical stream of bellboys goes through and, of course, pushes these couples a little bit. The couples start moving, and, if that happens frequently and many bellboys go through the motion of the couples in the room will increase greatly. That is how

electricity creates heat! [Laughter.]

The nice part of that is the following: You can figure quantitatively how much heat is created. All you have to do is find out how many electrons are connected with a current of 1 ampere, which is 10^{19} electrons per second, figure how many molecules there are in the room and then you can compute how much energy from these bellboys is given up to the different couples. The result comes out with an accuracy of three decimal positions.

Dr. Krusen: Thank you, Dr. Lion. Why is reaction to ultraviolet light delayed? Dr. Williams, as our radiation physicist, might well answer that.

Dr. Williams: It is an erythema reaction. Why it is delayed, I don't know. I might continue to answer by saying the erythema is not produced by ultraviolet radiation. I have been struck by the idea that if you apply heat, considerable quantities of heat, you get erythema instantaneously. I believe it is due, to a great extent at least, simply to an increased amount of blood near the surface of the skin. It is a reddening of the skin produced largely by the great amount of blood there. If you use ultraviolet radiation, the erythema does not occur immediately but appears a few hours after the exposure ordinarily. After exposure to long wavelength x-rays, the erythema appears three or four days after the exposure. When we get to the short x-ray region and give an exposure, the erythema appears a week to ten days after exposure. When we get to the gamma region, the erythema comes from one to two weeks—or maybe later than that—after the exposure.

There seems to be a progressive change, a lengthening of this latent period as the type of radiation gets shorter. I might ask the question, Is erythema produced by radiation? Strictly speaking, I don't believe it is. The effect of any radiation on any material, tissue, for example, is only produced during the period of irradiation. As soon as the radiation stops, the effect of the radiation itself ceases.

The only statement I believe we can safely make at the present time as to the effect of radiation on tissue or any material is that it increases the energy content of that material. How or in what form that increased energy content appears depends somewhat on the type of material being irradiated and many other factors. A few points that we are sure of are that frequently at least, the radiation increases the osmotic pressure of body tissue and fluids. It breaks down molecules and increases the number of particles in solution; that corresponds to an increased amount of osmotic pressure. At that time the chemical changes occur. They are produced as a result of irradiation. The atoms and molecules are broken up and recombined in different form. Whatever happens, the thing that we can be sure of is that the energy content of the medium has been increased. In a sense, I think that we cannot say that what happens at some future time is primarily due to the radiation. It follows radiation as a secondary type of reaction. It results from the attempt of the tissue primarily to recover from the damage or injury which has been done in that process of irradiation. Many different types of chemical reactions take place in the tissue, and at some place along that line erythema may occur. I rather suspect that erythema is primarily due to the liberation of some chemical in the tissue. If that chemical happens to be produced in this long series of complicated reactions which follow the absorption of the energy, at the same time; and, at least after exposure to some types of radiation, we have more than one erythema appearing at different times after the radiation.

Dr. Krusen: Do microwaves produce effects on living tissues which differ from the effects of diathermy? Dr. Herrick spoke to me with respect to some remarks made by Dr. Condon. Since both she and Dr. Lion have been working in this field, I will call on Dr. Herrick first to comment.

Dr. Herrick: Of course, Dr. Lion really stuck his neck way out yesterday when he said that microwaves will do only one thing, and that is heat. Mr. Carter's last remark last evening was that diathermy will do that.

Tissues will absorb more energy from the microwaves than from the short wave, and, as Dr. Lion pointed out the other day, the energy of these waves is $h \cdot \nu$. Where ν is the frequency, the energy of radiation is equal to a constant times the frequency. It is proportional to the frequency. In certain gases, it happens that a certain notational property of the molecule, dipole moment, does resonate at a particular frequency, and during the war one of the fundamental problems was the study of the absorption of microwaves by the atmosphere. That was a problem that descended upon the physicists after it was discovered experimentally that the atmosphere played tricks on them when they tried to use radar. The molecules are in the gaseous state in an uncondensed atmosphere. Dr. Kurt Lion made it clear that when the molecules are in the solid state perhaps the difference in selective absorption will no longer prevail. I am going to say that as yet I do not know whether or not selective absorption by biologic materials takes place. All I can do today is to tell you that we do know that it heats. No one doubts that. That

it heats better is to be taken from the fact that investigators at the radiation laboratory have shown that the absorption factor for water at 100 F. is 7,000 times more at 450 megacycles than that at 27 megacycles. If it does nothing but heat, it may heat better. If it does something else besides heat, then it may show selective absorption.

Whether the molecules of the human body will show selective absorption as do the molecules in the atmosphere is not as yet proved, but there has grown up an interesting new field of research known as microwave spectroscopy which is providing considerable interesting information on molecular structure.

I shall conclude my remarks by quoting from an article by Dr. Condon which was published in the *Review of Modern Physics* for October, 1942: "We must not overlook the fact that the applicability of microwaves to medical diathermy is thus far completely unexplored and that they may well prove to have specific therapeutic effects not possessed by the lower frequencies in use at present.'"

DR. KRUSEN: That was in 1942. Dr. Lion, do you have any comments with regard to this question?

DR. LION: Perhaps I have the urge to stick my neck out again and to say that Dr. Condon does not say that there are specific physical effects, but he claims that there might be specific therapeutic effects. So far, I don't think there is any question. As I pointed out yesterday, the important difference between treatment with microwaves and treatment with diathermy short waves in the condenser field is the different distribution of energy in the two cases. That may or may not lead to new therapeutic effects, and it is up to the physiologist now to determine that. I can say that it is perhaps safe from my point of view to predict that no wavelength specific effects are to be expected and we can conclude from the material available right now that it is unwise to speculate on such possible effects in the future.

DR. KRUSEN: Thank you, Dr. Lion. Our time is practically up. We have perhaps a chance to answer one more question. This question is of considerable interest to certain clinicians. We can't answer this completely, experts, but let's touch on it for a moment before we close. What kind of current is most efficient for (1) muscle stimulation, (2) nerve stimulation and (3) ion transfer?

MR. CARTER: I'll take the ion transfer.

DR. KRUSEN: We will pass that one by. It is generally agreed that the constant current is best for common ion transfer. What kind of current is most efficient for stimulation of muscles?

DR. LION: I am looking forward to the results of Dr. Rose's most splendid work. If he works for two or more years on it, we shall know the answer.

DR. KRUSEN: I think we have had a very pleasant and enjoyable round table conference and with such a group of experts. We clinicians are very happy to have them with us. Our part of the program is adjourned.

ROUND TABLE ON BIOPHYSICS AT WASHINGTON, D. C.

The Round Table on Biophysics will be repeated at the 26th Annual Session. If you have some question which you would like discussed you are urged to submit same to the chairman of the program committee, American Congress of Physical Medicine, 30 North Michigan Avenue, Chicago 2, Illinois.

MEDICAL NEWS

New York Society of Physical Medicine

The following scientific program was presented at the regular monthly meeting for March of the New York Society of Physical Medicine: "Electromyography of the Trapezius," William Bierman, M.D., and Leonard J. Yamshon, M.D.; "Functional Rehabilitation of the Severely Injured Hand," Edgar Bick, M.D., (by invitation). The general discussion was opened by Dr. Robert L. Patterson (by invitation).

Pennsylvania Academy of Physical Medicine

A meeting of the Pennsylvania Academy of Physical Medicine was held Thursday, Feb. 19, 1948, at the Erny Amphitheatre, Temple University, Philadelphia. The following papers were presented and discussed. "Surgical Treatment of Spondylitis Rhizomelique," by Dr. J. R. Moore; "Muscle Transplantation in Poliomyelitis," by Dr. L. W. Jordan; "Intracapsular and Intertrochanteric Fractures in the Aged," by Dr. Arthur Seifer.

New Film Available

The Surgeon General announces the completion of another of the series of films produced by the Signal Corps under the supervision of the Army Medical Illustration Service and the Physical Medicine Consultant's Division. This film, "Toward Independence," designated PMF 5055, deals with the rehabilitation of patients with spinal cord injuries. Application forms for loan of prints to medical groups may be secured by writing to the Commanding General, Headquarters, of the appropriate Army Area, Attention: The Surgeon.

Soldier Reactions to Heat, Cold Tested in "Operation Windchill"

Army Medical Department researchers have undertaken exhaustive experiments, with the cooperation of the U. S. Air Force, to determine, through "Operation Windchill," what might happen to the physical and psychologic well-being of soldiers suddenly transported by air from warm climates to extreme Arctic cold in a possible future war. The object of the Army Medical Department is to determine exactly what changes take place in the bodies of these men in the course of adjustment to extreme cold. For several weeks before leaving Florida they were subjected to about every physical test known to medical science. Those tests ranged from the ordinary basal metabolism and blood pressure measurements to complete blood chemistry. Sulfur content of red cells, Vitamin C content of blood cells and plasma, complete urine chemistry, concentration of sex and adrenal hormones and their precursors and analysis of body fats were among the determinations.

Once the men arrived at their Arctic base the tests were started all over again.

Indiana Vocational Rehabilitation, Its Organization, Scope and Services

Vocational rehabilitation was established in Indiana by the 1921 General Assembly's enactment of the Acceptance Act. Several revisions have broadened the scope of the original act. However, the primary objectives of the program is to provide one or more of a number of rehabilitation services which may be necessary to render a disabled person fit to engage in a remunerative occupation.

Major Vogel Appointed Chief of Women's Medical Specialist Corps by Surgeon General

In the first move to establish the Women's Medical Specialist Corps recently authorized by Congress as a part of the Regular Army Medical Department, Major General Raymond W. Bliss, The Surgeon General, today announced the appointment of Major Emma E. Vogel as Chief of the new Corps with the rank of full Colonel. Colonel Vogel was administered the oath of office in a brief ceremony December 5, 1947 in the Office of The Surgeon General.

Colonel Vogel will assume supervision of what has heretofore constituted three separate sections of the Medical Department. These were the Dietitian Section, the Physical Therapist Section, and the Occupational Therapist Section.

The first task confronting the new Chief of Corps will be the integration into the regular army of qualified applicants for commissions. As integration proceeds, three officers will be selected to head the three branches of the Women's Medical Specialist Corps. These women will be commissioned as lieutenant colonels. Prior to today, no woman has held rank higher than that of Major in any of these three specialist groups.

Colonel Vogel is regarded by the Surgeon as the nation's outstanding physical therapist. Appointed in 1942 as director of Medical Department Physical Therapists of the Army, she was the first woman to hold this title.

The authorized strength of the Women's Medical Specialist Corps will be in the ratio of nine-tenths of a member for every 1,000 persons in the total authorized strength of the regular Army with

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.·. EDITORIALS .·.

FUTURE AIMS OF PHYSICAL MEDICINE

Physical Medicine has had to overcome many handicaps to its development as a branch of scientific medicine. While some of the common physical agents have been employed by lay people through the ages and have frequently been misused by the ignorant and overenthusiastic, careful and critical observations have been made only during the last few decades. Medical schools and research institutes have shown indifference towards physical medicine until recently. It is well known how the two world wars have changed the attitude of the medical profession towards physical medicine. The problems of rehabilitation of the wounded and sick and the significance of the direct physical care of many diseases became better understood. Research centers in connection with medical schools were set up and planned training for future specialists has been established. Undergraduate training in physical medicine is now given in 60 of the 70 medical schools in the United States.

The question is now: What is the outlook and what shall be the future aims in physical medicine? It seems unlikely that great technical advancements can be expected in the near future. Rehabilitation may be expanded into certain other fields and undergo further developments. Most important appears to be to strive towards a solid scientific background and to become fully acquainted with the physiologic and pharmacologic basis of therapeusis by physical agents. It is also important to study diagnostic measures related to physical medicine. In many instances these fields in research are as yet barely touched. Their ramifications extend far and wide and their preliminary investigation may sometimes appear remotely connected with physical medicine. At the same time, basic sciences must be combined with clinical investigation. Again the ramifications extend far and wide, into neuropsychiatry, internal medicine, orthopedics, surgery, gynecology. The specialist in physical medicine must acquire enough knowledge in the fields to apply and evaluate his measures critically.

The future of physical medicine rests in the men who already devote themselves to it. Men and women must be found who spend all their efforts in the study of basic problems. Others are wanted, to work for years in basic science and then apply their knowledge to clinical problems. And still others are needed who after similar basic science training acquire wide clinical experience and utilize it in the practice of physical medicine. Each group in itself and the three groups together will assure the continued progress of physical medicine. Hence, the most important obligation of those established for years in physical medicine is to find and to assist workers of tomorrow stimulating and guiding their efforts.

It is also an obligation to awake the interest and obtain the respect of other branches of medicine. One of the means to this end is the mutual par-

ticipation in scientific meetings and publications. This is, of course, only possible if the subject matter of such meetings is of general importance and if the specialist in physical medicine has a firm background in basic science and clinical medicine beyond his immediate field. The need for such training and knowledge is clearly expressed in an introduction to the therapeutic conferences at Johns Hopkins Hospital,[1] as follows:

"The approach to the problems of treatment is based on presenting the fundamental mechanisms of the disease concerned, the physiologic action of the pharmacological agents which are used in the treatment of that disease and our clinical experience. This is . . . an effort to place our management of the treatment on a scientifically sound and a rational a basis as possible." It is evident that our attitude and procedure in establishing the scientific basic for physical therapeutics should be the same.

1. Bull. Johns Hopkins Hospital 81:6 (Dec.) 1947.

SPECIAL EXHIBIT ON PHYSICAL MEDICINE AT THE ANNUAL MEETING OF THE AMERICAN MEDICAL ASSOCIATION

For the third consecutive year the board of trustees of the American Medical Association has appointed and subsidized a special Exhibit Committee on Physical Medicine to prepare a large special exhibit on various phases of physical medicine. A feature of the exhibit this year will be a demonstration on supersonics as related to medicine. We can expect to hear more concerning various applications of the supersonic high frequency sound waves in medicine, and it will be interesting to learn about some of their characteristics. Once more there will be a series of live exhibits on such subjects as physical rehabilitation as related to cardiac disease, and physical treatment following thoracic surgery.

It is to be hoped that these demonstrations will continue to familiarize the rank and file of the medical profession with the growing importance of physical medicine.

SPECIALISTS IN PHYSICAL MEDICINE IN THE NEW AMERICAN MEDICAL ASSOCIATION DIRECTORY

The way has been cleared for listing of physicians who wish to designate themselves as specialists in Physical Medicine in the forthcoming Directory of the American Medical Association. The physiatrist will be listed according to present plan if he specifies that he wants such listing. The letters P.M. signifying specialization in Physical Medicine will be placed before his name, and this new classification will be included in the list of medical specialties.

In addition physiatrists who have qualified under the new American Board of Physical Medicine will also be listed automatically in the forthcoming Directory of Medical Specialists which is published by the Advisory Board for Medical Specialties.

SESSION ON PHYSICAL MEDICINE AT THE ANNUAL MEETING OF THE AMERICAN MEDICAL ASSOCIATION

During the annual meeting of the American Medical Association in Chicago there will be a session on physical medicine in the Section on Miscellaneous Topics. The session is scheduled for Thursday morning, June 24, 1948, in the auditorium at American Medical Association Headquarters, 535 N. Dearborn Street.

There was excellent attendance at the first session held in conjunction with the American Medical Association meeting in Atlantic City last June, and it is to be hoped that there will be an equally good attendance this year. Dr. George Morris Piersol has been appointed, Chairman and Dr. Frank H. Krusen, Secretary of the session.

GALVESTON DOES IT AGAIN

The Third Annual Postgraduate Course in Physical Medicine and Rehabilitation of the Medical Branch, University of Texas, held at Galveston, March 1 to 5, 1948, fully equaled in scope, spirit and record attendance the two preceding courses. The members of the faculty of the University of Texas, under the genial leadership of Dean Leake and with the indefatigable planning of Dr. W. A. Selle, again participated wholeheartedly, expecially Drs. Blocker, Calvin, Eggers and Randall. A brilliant faculty of guest speakers included our popular visitor from England, Dr. James B. Mennell, now assistant professor of physical medicine at the University of California, and teachers from all parts of the United States. Among these were Bennett of Warm Springs, Kendell of Chicago, Kovács of New York, Krusen of Rochester, Osborne of Chicago, Polmer of New Orleans. Other outstanding participants were leaders of the Veterans Administration; Dawson and Knudson of Washington, D. C. and of the U. S. Army; Colonel Smith, Walter Reed Hospital; Colonel White of Percy Jones Hospital; Lt. Col. Tate of Ft. Sam Houston, and also Frederic T. Jung, Assistant Secretary of the Council on Physical Medicine. The National Foundation for Infantile Paralysis cooperated in providing some of these speakers. Miss Ruby Decker, Technical Director of Physical Therapy at the Medical School, ably assisted in all technical details.

The comprehensive program covering fundamentals as well as some advanced research and all phases of modern physical rehabilitation again attracted physicians, technicians, Army and Veterans personnel from some 31 states of the United States. The proceedings moved on an easy schedule and there was ample time for discussion. Instructional periods and active demonstrations added to the practical aspects of the course.

The social activities of the evenings and the lively hospitality extended was as delightful as ever before. One evening, Dr. Kendell, President of the American Congress of Physical Medicine, spoke impressively on the "Physiatrist," and Dr. Kovács on "American Spas," followed by fine color pictures on "Birds, Beasts, Babies and Blossoms"; at the annual dinner, Dr. Krusen presented with his usual eloquence, "Physical Medicine Yesterday, the Life of William Gilbert," and Drs. Jung and Kovács made a surprise musical offering. One sunny afternoon the professors of physical medicine even enjoyed real heliotherapy when fishing in Galveston waters. The last morning was given over to a public demonstration of modern methods of rehabilitation, while the afternoon was devoted to meetings of special groups, the Southern Section of the American Congress of Physical Medicine, the Texas Chapter of the American Physical Therapy Association and the Texas Occupational Therapy Association.

The Medical Branch of the University of Texas deserves much praise for continuing to fly the banner in the promotion of postgraduate teaching of physical medicine, combined with popularization of the subject of rehabilitation in the Southwestern States of the Union.

Medical News

(Continued from page 238)

a minimum of 24 officers in the grade of major and 385 other officers in grades of second lieutenant to captain.

It is expected that Colonel Vogel's duties will include: consultant to the Surgeon General on all matters pertaining to the Women's Medical Specialist Corps; planning and initiating of training programs; the formulation of tables of organization and equipment; and the planning and execution of operations pertaining to procurement, assignment, and promotion of members of the new Corps.

Cerebral Palsy Preschool Center

Lenox Hill Hospital opened a cerebral palsy preschool center, November 17. The clinic began the rehabilitation of children before they start to school. According to Dr. George G. Deaver, medical director, fifty children will be carried as regular visitors to the clinic and an additional number will be helped by parental instruction. Although a fee of $2 is charged for each visit, the clinic is almost wholly financed by the New York State Association for Crippled Children, the National Society for Crippled Children and Adults, and Lexon Hill Hospital.

Infantile Paralysis Research

A new associate director to help coordinate the expanding research program of the National Foundation for Infantile Paralysis, Dr. Theodore E. Boyd, has been appointed by President Basil O'Connor. Announcing the appointment, Mr. O'Connor stated that Dr. Boyd would maintain a running survey of progress in the field of poliomyelitis research and of achievements of the National Foundation's grantees. In addition he will seek to coordinate the findings and recommendations of recent and future round-table conferences on various aspects of the research program.

Dr. Boyd, a veteran of World War I, has been a member of the faculty of Loyola University's School of Medicine since 1923.

Mississippi Opens Hospital School for Spastics

Rehabilitation in the State of Mississippi has taken a step forward with the recent opening of a hospital school for cerebral palsied children. One ward of the Jackson Charity Hospital has accepted 20 children from all sections of the State for training following examination by Dr. R. E. Bruner of Kansas City, and Dr. N. B. Bond, Psychologist, Jackson, Mississippi. Medical expenses of the hospital school will be borne by the Crippled Children's Service of the State Department of Education; the Mississippi Society for Crippled Children and Adults will furnish a teacher for the children.

It has been estimated that approximately 2,000 children in Mississippi suffer from cerebral palsy and that three-fourths of them can be improved by proper treatment.

Promotional work leading to the establishment of this hospital school was done by the Mississippi Association for Spastics, which is now a section of the Mississippi Society for Crippled Children and Adults.

Second Annual Amputee Institute

The second annual "Amputee Institute" will be held beginning Thursday, April 1, and will continue each Thursday during the month of April, 1948. This program will be held at the Hasbrouck Heights Hospital, Hasbrouck Heights, N. J. The Hasbrouck Heights Hospital and the Office of Vocational Rehabilitation will be co-directors. The purpose of this Institute is to correlate the efforts of the general surgeon, the orthopedic surgeon, the limb manufacturers, the amputee, and other associated interests in an effort to give the civilian the same care the various Armed Services have given.

It will be under the direction of Dr. Henry H. Kessler and will be co-sponsored by the New Jersey Rehabilitation Commission, the New Jersey State Elks' Crippled Children's Committee, Associated Limb Manufacturers of America, the Hasbrouck Heights Hospital Association, the National Council on Rehabilitation, Crippled Children's Commission (New Jersey), the Council on Industrial Health and Council on Physical Medicine of the American Medical Association.

Subjects to be stressed are: psychologic preparation of the patient; the surgical care of the patient; orthopedic after-care of the stump; selection, manufacture, and fitting of the proper type of prosthesis; and training of the amputee to use his limb.

The tentative program is as follows:

April 1—National Program for Amputees. General Principles of Amputee Rehabilitation.

April 8—Surgery of Amputations. After-care of Amputee Stump.

April 15—The Selection, Manufacture and Fitting of the Proper Type of Prosthesis, Including Fabrication.

April 22—Below and Above Knee Amputation. Below and Above Elbow Amputation. Bilaterals.

April 29—Disarticulation of hip; hind quarter amputations. Training of Amputee; Walking; Balance; Posture, etc.

This Institute is open to rehabilitation personnel of all states. There is no tuition fee. There is a $10 registration fee. Further information on registration may be obtained from the Amputee Clinic, Hasbrouck Heights Hospital, Hasbrouck Heights, N. J.

In connection with this Institute, a rather intensive course in amputation selection of pros-

thesis, etc., will be given for physicians on these days from 9:00 A. M. to 12 Noon, 2:00 P. M. to 5:00 P. M. There will also be daily clinical demonstrations.

Homework for Shut-ins

Although homework programs for the blind are not uncommon, there are few programs in the country of the type conducted by the bureau for physically handicapped shut-ins. In attempts to eliminate the sweatshop and its vicious by-products the Government adopted stringent regulations governing homework. Although highly desirable, these regulations make difficult the administration of a homework program such as the bureau's.

The Brooklyn bureau is limited by law to serving not more than seventy-five home-bound clients at one time. Yet there are 345,000 persons in New York disabled by chronic illness; more than 80,000 of this group are permanently disabled. Many of these persons are being cared for in hospitals and nursing homes, but the great majority, over 25 per cent of whom are under the age of 65, live at home. The opportunity to have some productive, remunerative activity within their own homes would mean the difference between utter boredom and its accompanying psychological problems, and purposeful living.

The administrative costs of conducting such programs are relatively high, but are more than off-set by their returns. The department of the handicapped of the Brooklyn Bureau of Social Service has demonstrated that such programs can operate effectively without the exploitation that characterized the sweatshops of a few decades ago. Theirs is a program that could well be expanded not only throughout this city but the nation.—Rusk, N. Y. *Times.*

Medical Schools Well Represented in Course on Atomic Medicine at Army Medical Center

More than 20 of the country's schools of medicine sent representatives to the five-day intensive course on medical aspects of atomic explosion which was held at Army Medical Center, Washington, D. C. Sponsored by the Armed Forces Special Weapons Project, medical services of the armed forces and the Veterans Administration, the primary purpose of the training program is to portray the various types of injury produced by atomic blast and outline fundamentals of treatment. Students are drawn chiefly from the Army, Air Force, Navy, Public Health Service, Veterans Administration and other Federal agencies. Given once each month since last October, the course was opened in December for the first time to medical school representatives.

Annual Meeting West Virginia State Medical Association

Announcement is made of the 81st Annual Meeting of the West Virginia State Medical Association, to be held May 10 to 12, in Huntington.

A. M. A. House of Delegates Takes Action on Economic Relationship

Recognizing the fact that the specialties of Anesthesiology, Radiology, Pathology and Physical Medicine are a part of the practice of medicine, the House of Delegates of the American Medical Association at a meeting in Cleveland in January, recommended appointment of a committee to study the subject of economic relationship between members of these specialties and the hospitals. Their object will be to work toward implementing resolutions on the subject previously passed by the House of Delegates.

This action was taken following a report of the Board of Trustees, who have taken the position that all doctors of medicine specializing in these four fields should be under the control of the medical boards and on the medical staffs of hospitals. They pointed out that mere passage of resolutions was not taking care of the situation as had been anticipated. Detailed proceedings of this meeting will appear in a forthcoming issue of the A. M. A. Journal.

Infantile Paralysis Booklet Available

The 1948 edition of "Facts and Figures About Infantile Paralysis," a publication of the National Foundation for Infantile Paralysis, is now available to physicians and public health workers. Statistics on the disease, revised yearly, are gathered from the United States Public Health Service, state health departments and various other sources. Incidence of infantile paralysis in the United States is shown in tables, maps and charts. Other statistics furnish information on age and sex distribution, case rates, crippling conditions and mortality. For the first time, this publication includes data on the disease in foreign countries. Copies of the booklet (No. 59) may be secured free of charge by writing Education Service, The National Foundation for Infantile Paralysis, 120 Broadway, New York 5, N. Y.

Drs. Piersol and Rusk Speakers

Dr. George M. Piersol spoke on "Possibilities of Physical Medicine from the Standpoint of the Internist," before the Annual Clinical Conference of the Chicago Medical Society, Chicago, March 3.

Dr. Howard A. Rusk spoke on "Rehabilitation and the Heart," at the meeting in Chicago of the Chicago Heart Association.

Preventive Medicine Gets Interim Specialty Board

Consultants and practitioners of preventive medicine, one of the least formalized but most universally important branches of medical science, today learned that a great forward step toward professional recognition of their calling as a distinct medical specialty has been made by the formation of an "Interim Board" of Preventive Medicine. Announcement of the move was made jointly by the Surgeons General of the Army, Navy and U. S. Public Health Service.

Midwestern Sectional Meeting Congress

The officers of the Midwestern section of the Congress are to be congratulated on the success of the recent meeting held at Veterans Administration Hospital, Hines, Illinois, in the form of a two-day seminar on spinal cord injuries. Over 400 persons registered for the sessions and came from many states, Illinois, Michigan, Indiana, Iowa, Wisconsin, Oklahoma, Missouri and Ohio.

The opening address of Dr. Carroll, manager of the hospital set the keynote of the main theme, how better to provide care for our wounded veterans. Dr. Loyal Davis was the first speaker and presented the neurosurgical aspect of spinal cord injuries, emphasizing again, that the combined efforts of all medical personnel is directed towards any possible methods that might be discovered to improve on the present known line of treatment. Most of the speakers who followed carried out this trend of thought. The interest in this form of presentation, that is, concentration on one particular field, certainly seems to warrant future sessions planned along such lines.

Occupational Therapy News

Milwaukee-Downer College observed the 30th anniversary of its Department of Occupational Therapy with a program on March 23. Speaker for the occasion was Dr. Howard A. Rusk, of New York City.

Miss Henrietta McNary, OTR, Director of the Department of Occupational Therapy at Milwaukee-Downer, was in charge of an exhibit to picture the past and anticipate the future of occupational therapy as it serves the sick child, and adults suffering from nervous or physical disorders.

The Department of Occupational Therapy was set up at Milwaukee-Downer in 1918, the first in any college. It was established by Elizabeth Upham, now Mrs. Carl H. Davis of Wilmington, Del., in response to the call of General John J. Pershing, Commander-in-Chief of the American Expeditionary Forces, asking for 1,000 women volunteers to do "bedside occupational work." In 1918 the term "occupational therapy" was first used and a new profession was born. Marjorie Taylor, Director of the Department at Milwaukee-Downer from 1929 to 1939, working closely with the American Medical Association and the American Occupational Therapy Association, developed it into a course leading to a B.S. degree with a major in O.T. Miss McNary has directed the department since 1939, and also conducted emergency courses for the Army during World War II.

Professional standards for all occupational therapists in the U. S. Public Health Service have been authorized, according to Federal Security Administrator Oscar F. Ewing.

Occupational therapists in hospitals operated by the Service will be reclassified from subprofessional grades P-1, P-2 or P-3, if they are graduates of approved schools of occupational therapy, or have experience giving them comparable qualifications, and are performing professional O. T. work.

Unlike the physical therapist category in Public Health Service, which also was recently converted to professional status, the subprofessional status for occupational therapists will not be eliminated. Occupational therapy aides still will be needed in the subprofessional grades.

Qualified Public Health Service occupational therapists will not be converted from subprofessional to professional status immediately. Individual job descriptions first must be prepared by the incumbents and revised by the Classification Section in order to determine the appropriate professional grade.

State Legislation

S. 458, New York, to amend the public health law, proposes the creation of a board of massage examiners and defines massage as the stroking, kneading, tapping or rolling with the hands, or with other instrumentalities, of the human body for hygienic or remedial purposes, for the purposes of relieving, alleviating or reducing affected parts thereof, but shall not include reduction of a fracture or dislocation of a bone.

Osteopathy

Osteopathic physicians now are authorized to provide out-patient treatment within certain limits to veterans with service-connected disabilities, Dr. Paul P. Magnuson, chief medical director of Veterans Administration has announced.

"Within the limits of practice of the healing art imposed by their respective state licenses, osteopathic physicians, when their services are requested by veterans, may be designated to provide out-patient treatment, on a fee basis, for service-connected disabilities under the same rules and regulations as govern such service by doctors of medicine," Dr. Magnuson stated. Public Law 298, 79th Congress, authorizes VA to hire doctors of osteopathy to work with veterans. All treatment given by doctors of osteopathy or doctors of medicine under the "home town" medical care program must have prior approval of VA.

A bill to amend the Public Health Service Act in regard to certain matters of personnel and administration, S. 1454, has passed the Senate. Before passage, the bill was amended by the adoption of an amendment submitted by Senator Smith, New Jersey, providing that graduates of colleges of osteopathy whose graduates are eligible for licensure to practice medicine or osteopathy in a majority of the states of the union, or approved by a body or bodies acceptable to the administrator of the Federal Security Agency, shall be eligible, subject to the other provisions of the Public Health Service Act, for appointment as commissioned medical officers in the Public Health Service.

BOOK REVIEWS

THE PATHOLOGY OF TRAUMATIC INJURY. A General Review. By *James V. Wilson*, M.D., M.R.C.P. (Lond.), Major R.A.M.C. (T.), Pathologist to Harrogate and District General Hospital, and the Royal Bath Hospital, Harrogate. Sometime Associate Professor of Pathology, Farouk I. University, Alexandria, and Pathologist to the Anglo-Swiss Hospital, Alexandria, D.A.D.P., Malta Command, 1940-1943. Cloth. Pp. 192. Price, $6.00. Baltimore: The Williams & Wilkins Company, 1946.

This timely monograph presents recent advances in our knowledge of trauma. The first half of the book deals with shock, burns, crushing and blast injuries, fat embolism and wound infection. Much of the information comes as a result of wartime experience in England.

The remainder of the book includes chapters on injuries to the chest, blood vessels, abdomen, nervous system and bones and joints. The last two chapters are of most interest in relation to Physical Medicine, but there is little new on these subjects. The emphasis of the entire book is focused on surgical problems rather than aftercare and it is recommended as a useful reference for the surgeon's library.

MEDICINE TODAY. The March of Medicine, 1946. Pp. 177. Price, $2.00. Cloth. New York City: Columbia University Press, 1947.

The eleventh series of Lectures to the Laity held at the New York Academy of Medicine in 1945-46, was appropriately devoted to a reevaluation of present-day methods of medical practice as well as of medical education and research upon which the practice of medicine is predicated. Their titles are successively: Medicine today: its assets and liabilities, by John F. Fulton, M.D.; the making of the doctor, by Willard C. Rappleye, M.D.; the hospital and the laboratories, by Basil C. MacLean, M.D.; the general practitioner and the specialist, by Donald M. Clark, M.D.; research in the medical sciences, by Edwin J. Cohn, Ph.D.; the Layman's part in preventive medicine, by Edward S. Rogers, M.D.; and economics and medicine, by Dean A. Clark, M.D. Of particular practical and cultural interest to physiatrists is the article of Dr. Cohn enlivened by four excellent charts tabulating natural philosophy, discoveries of natural substances and the discoveries of physics, biology, physical chemistry and medicine. It shows impressively the interdependence of the medical and natural sciences. These articles are of special value to the individual whose interest is nonprofessional; their study also provides an all around better understanding of the many interrelated factors in furnishing the "adequate" medical care which is so much spoken of these days. While a review of economics and medicine indicates that present methods of paying for medical service and of delivering it have many faults, the experience of many years, however, also shows that improvements are possible: that the public can secure comprehensive medical care of high quality if group medical practice and insurance payments, aided by tax support, are properly planned and substituted for the current haphazard arrangements; that medicine can once again treat the patient as a person; that medical education and research can gain immeasurably: that an integrated system of community health services, local, state and national, is for the first time a real possibility; finally, it also maintains that most physicians can have both more satisfying professional careers and more rewarding economic opportunities.

KINESIOLOGY LABORATORY MANUAL. By *Leon G. Kranz*, M.S., Professor of Physical Education and Chairman of the Department, Northwestern University. Paper. Pp. 177. Illustrated. Price, $2.75. St. Louis: The C. V. Mosby Company, 1948.

In this book the movement of individual muscles and, to a lesser extent, group action is taught by means of drawings to illustrate skeletal attachments and pulls of the respective muscles. Verbal descriptions are brief and in outline form for the most part. The function of the hand and foot muscles is not illustrated. Certain gymnastic maneuvers are analyzed and review questions are added for the different regions of the body. The binding is plastic loose-leaf which is ideal for student use. This manual should be welcomed by teachers and students in physical education, physical therapy and occupational therapy. As a reference for medical students and doctors the addition of nerve supply would make it more valuable; also an index.

INTERNAL MEDICINE IN GENERAL PRACTICE. By *Robert Pratt McCombs*, B.S., M.D., F.A.C.P. Assistant Professor of Medicine and Director of Postgraduate Teaching, Tufts College of Medicine. Second Edition. Cloth. Pp. 741 with 122 illustrations and 15 tables. Price, $8.50. Philadelphia and London: W. B. Saunders Co., 1947.

One of the most significant traditions in the progress of the healing art is the democracy of opinion which has periodically interpreted the trend of evolution in our profession. This very intellectual dynamism was protection against intuitive empiricism and fads, and seldom has it had to look for dogmas to guide its destiny to its present stages of rational teaching and practice. Though every great period in world history left

its imprint on the pages of medical history, much of the opinions and practices in vogue in the past has been found wanting and become obsolete. This contrast between outworn tradition and modern progress is well illustrated as one reviews the text of this highly informative second edition and notes the rich contributions of the last several decades.

McComb has performed a major revision in order to give wider space to the new and accepted advances in the diagnostic and therapy of internal medicine, and contracted or deleted controversial material or technical procedures which belong mostly to the domain of specialists. Particularly has stress been layed upon such problems in which errors in diagnosis are most frequent or integrated with basic physiologic principles. Throughout the text diagnostics is shown to have a place of equal importance with therapy and the balance is fairly well maintained throughout the entire exposition and are included in the generous bibliography. The section of chemotherapy has been completely rewritten and calls attention to the abuses and uses of penicillin, streptomycin and the efficacy of the sulfonamides when values are logically interpreted. Many of the new therapeutic methods are included, among them to mention a few, are the rice diet in hypertension states and certain kidney diseases; high protein diets and protein hydrolysates in malnutritional conditions; folic acid in macrocytic anemias, and other advanced measures too detailed to discribe because of limited space at one's disposal. The text is divided into sixteen chapters and expatiates on a fairly large but most important group of diseases, ranging from the infection; hypertensions; nutritional deficiencies; heart, lungs and circulation; gastrointestinal affections; rheumatism; allergies and endocrine states, and the like. From the aesthetic point of view, even the average run of bibliophiles will voice their admiration at the luminous pages with beauty of format and great readability of type. Here is a book which in scholarship and timeliness qualifies to rank with the top contemporary contributions on internal medicine in general practice.

DR. KIRKBRIDE AND HIS MENTAL HOSPITAL. By *Earl D. Bond*, M.D. Cloth. Pp. 163 with 7 illustrations. Price, $3.50. Philadelphia: J. B. Lippincott Co., 1947.

The life of Thomas Kirkbride shows the durable satisfaction of a driving force in full agreement with conscience; a glimpse into the world of mental disorders, into an experimental Utopia in a mental hospital and into psychiatric principles which are just as true today as they were a hundred years ago.

Kirkbride's life stands as an example of a man whose deeds and pleasure are pulled together in the tightest integration that can be imagined. What he wanted to do for his own pleasure helped others. Everyone knows that the Pennsylvania Hospital for the Insane is Kirkbride's. Dr. Kirkbride's Hospital stood out against the background of the degree of civilization which Philadelphia had reached in 1841.

Paradoxically, we have gone a long way yet come back to where Dr. Kirkbride always stood. He took for granted that a patient is first of all a person to be respected, not to be considered as a mere envelope for a set of organs, nor as the undifferentiated unit of the multitude of souls lost in the darkness of the world of mental disorder. This is an interesting book about a great man.

MEDICAL ASPECTS OF GROWING OLD. By *A. T. Todd*, M.B. (Edin.), M.R.C.R. (Lond.), Honorary Physician, Bristol Royal Infirmary. Cloth. Pp. 164. Price, $3.50. Baltimore: The Williams & Wilkins Company, 1946.

The science of old age, geriatrics, must increase in importance in the years to come for the number of old people is increasing in proportion to the general population. This book presents the problem in language as simple as possible but retains factual clarity and so will help the elderly subject who desires to make the most of his later life and to correct the many errors which may be made before extensive ravages have occurred. It will also assist the general practitioner who may wish help in the treatment of elderly subjects.

THE AMERICAN ILLUSTRATED MEDICAL DICTIONARY. A COMPLETE DICTIONARY OF THE TERMS USED IN MEDICINE, SURGERY, DENTISTRY, PHARMACY, CHEMISTRY, NURSING, VETERINARY SCIENCE, BIOLOGY, MEDICAL BIOGRAPHY, ETC., WITH THE PRONUNCIATION, DERIVATION AND DEFINITION. By *W. A. Newman Dorland*, A.M., M.D., F.A.C.S., with the Collaboration of E. C. L. Miller, M.D., Medical College of Virginia. Twenty-first Edition. Pp. 1660, 880 illustrations, including 233 portraits. Fabrikoid. Price, $8.50. Philadelphia and London: W. B. Saunders Company, 1947.

Any reader who studiously searches for the derivation of a word or phrase, its pronounciation or nuance eventually must arrive at the opinion that the task of compiling a modern dictionary has outgrown the power of any single individual no matter how exceptionally endowed. Unlike the days when a Samuel Johnson could boast that his work of eight years was accomplished with little assistance from his learned colleagues, the expansion of knowledge within technical and specialized fields of modern science has so vastly increased the burden of contemporary lexicographers and philologists as they explored the many thousands of avenues for the exact definition of words or the deletion of obsolete ones that the assignment had to be organized into one of wholesale cooperation by highly specialized associates, under an editorial board. Such has been the teamwork behind the many years of labor in the compilation of the 21st edition of this medical dictionary. It is an adventure in high finance, underwritten behind a curtain of anonymity of an able executive staff. While the cost in this instance is unknown, the inference of special financial cooperation may be drawn from a recent similar venture in dictionary printing by an American publisher, who spent over half a million dollars

as part of such an overhead. Dictionary making is today a matter of organized scholarship in partnership with big business.

The collective labor of such a task renders it difficult to pay homage to certain individuals who no doubt operated as catalytic agents in this contribution. The merit of this work certainly points to generous executive support of the house of Saunders and to the spiritual inspiration of Dr. Morris Fishbein, editor in charge of a highly diversified staff of specialists, and acknowledged in part in a preface eloquent in brevity. There are, however, occasions where brevity is a negative blessing. To the growing number of educated readers who prefer their intellectual pabulum with the spice of historic background, an increasing demand is voiced for an introductory section as an orientation, particularly to such a highly specialized subject as medical lexicography. The vacuum between preface and content of body not only is too abrupt a transition but lacks the intellectual foreword which few could more capably contribute than the editor of the American Medical Association.

In the field of medicine, the dictionary represents a creative effort, luminous in format and accurate in its definitions and terse biography. The quality of this book has now reached beyond such shopworn clichés as a "must," "timely," "needy," or even "handy." In the space of 47 years it has attained the mature stature of twenty-one editions, during which it has expanded in volume and scholarly accuracy to reflect the progress of medicine and the rich terminology developed within its highly technical field and allied branches. Today the dictionary has come to be appreciated not only as a classic but the companion and guide to all who search its pages for essential information. Unlike most books whose fate is the dust and silence of the upper shelf, this volume has so evoked the esteem and homage of our medical and allied professions as to assure it an honorable position in its own scholarly field.

TREATMENT BY DIET. By *Clifford J. Barborka,* B.S., M.S., M.D., D.Sc., F.A.C.P., Assistant Professor of Medicine, Northwestern University Medical School, Chicago; Attending Physician, Passavant Memorial Hospital; Consultant in Gastroenterology and Gastroscopy, Diagnostic Center, Hines Veterans Hospital; Formerly, Consulting Physician, The Mayo Clinic. New (5th) Edition. Cloth. Price, $10.00. Pp. 784 with 14 plates, including 13 in color. Philadelphia, London and Montreal: J. B. Lippincott Company, 1948.

This new (5th) edition incorporates today's accepted methods and concepts of treatment by diet. It gives the physician a practical and systematic method of prescribing diet and controlling nutrition by listing both the technical and corresponding household measurements of essential food quantities. This book will aid both physician and dietitian to combat the present volume of misinformation and teach the individual patient how to make a selection of the proper amount and type of food that has been prescribed for him. Full-color plates offer ready visualization of essential food requirements and comparative servings of cereals, bread and breadstuffs, dairy products, meats, vegetables and fruits. Avitaminoses are clearly pictured in life-like color. Under each disease the author gives a clear description of the nature and principal symptoms of the disease, the object of the diet in that particular condition and outlines important factors in the dietary treatment of such conditions. A new chapter has been supplied on deficiency diseases incorporating the newer concepts of nutrition and deficiency states. This chapter includes macrocytic anemias and hypochromic, microcytic anemias with many colored photographs demonstrating physical signs in patients with deficiency disease about the tongue, eyes and mouth. The chapter on liver disease has been rewritten to incorporate the newer conception of the application of protein and bring up to date the use of choline and other food factors utilized in treating cirrhosis of the liver, chronic hepatic diseases and hepatocellular jaundice. In the chapter on diabetes mellitus there has been taken out all the diets restricting carbohydrates below 100 Gms. and there has been added or reorganized a series of diets for diabetes to allow up to 250 Gms. of carbohydrate. According to the author he has purposely omitted excessive details and lengthy accounts of theories and has attempted to maintain the original purpose of the book, namely, to give physicians a simple, crystallized, practical and workable method of prescribing diets and applying treatment by diet to health and diseases.

INDUSTRIAL PSYCHOLOGY. By *Joseph Tiffin,* Ph.D., Professor of Industrial Psychology, Purdue University. Cloth. Price, $5.35. Pp. 553, with many tables and illustrations. New York: Prentice-Hall, Inc., 1948.

It is impressive to note that Tiffin's first edition went through eight printings; this, the second edition, first published in July, 1947, has already reached its second printing. The growth of interest in the field of industrial psychology has been almost phenomenal. Before World War II, only a few courses in industrial psychology were given by a limited number of colleges and universities. Now almost every department of psychology gives one or more courses in this subject. A decade ago, only a scattered few psychologists were employed by industry. Scores of psychologists are now well established in industrial jobs. According to the author the recent recognition of the contribution that can be made by psychology to the subject of job evaluation would seem to justify a coverage of at least the basic principles of job evaluation technics in a textbook on industrial psychology. Each chapter in the second edition has been thoroughly revised and much new material has been included. In addition, two entirely new chapters have been added, one of which deals with the interview and related procedures, the other with wages and job evaluation. There is included lists which give the title and publisher of the following tests: intelligence, clerical, dexterity and manipulative, mechanical, personality, interest, trade and industrial vision. The book is not intended for general reading but is a textbook which would need considerable background to be of value. For those in the field it is undoubtedly to be highly recommended.

PHYSICAL MEDICINE ABSTRACTS

Poliomyelitis. The Preparalytic Stage, and the Effect of Physical Activity on the Severity of Paralysis. W. Ritchie Russell.

Brit. M. J. **4538**:1023 (Dec. 27) 1947.

These case records make distressing reading in view of the evidence afforded by this body that physical activity is dangerous in the preparalytic stage. The danger of physical activity throws an extra responsibility on the practitioner regarding the need for early diagnosis. It should be emphasized that these records indicate not only that severe exercise in the preparalytic phase is highly dangerous, but that physical activity of any kind may be harmful. Physical activity of any kind during the preparalytic stage increases the danger of severe paralysis. Complete physical rest in bed during the whole of the preparalytic stage seems to protect the patient from severe paralysis.

The Prevention of Recurrence of Nasal Polyps. A Comparison of Results of the Postoperative Use of Radium and Zinc Ion Transfer. A. R. Holdender.

Ann. Otol., Rhin. & Laryng. **46**:932 (Dec.) 1947.

Nasal polyps recur frequently even after radical extirpation. Of the postoperative physical methods employed to prevent recurrence of polyps, electrosurgery, radium therapy and zinc ion transfer have been found effective in a large percentage of patients. While radium therapy and ion transfer are equally effective, the former is a more costly method and not always easily available. The results of zinc ion transfer compare favorably with the results of radium application in preventing the recurrence of nasal polyps. Neither radium nor zinc ion transfer is intended as a substitute for surgical extirpation, but merely as a postoperative procedure. The claims of certain authors that zinc ion transfer produces severe reactions, anosmia and other harmful effects are prejudiced and have not been borne out in several thousands of treatments. For the purpose for which it is here being advocated zinc ion transfer is a gratifying addition to the rhinologist's armamentarium.

Ruptured Intervertebral Discs in the Lower Lumbar Regions. R. Glen Spurling, and Everett G. Grantham.

Am. J. Surg. **75**:140 (Jam.) 1948.

In the experience of the authors the most effective measures are: Complete rest on a hard, flat bed until the acute pain has subsided. If the sciatic pain is severe, traction upon the affected leg may be beneficial. A well fitting low back brace made to the patient's own measurements is helpful once the patient becomes ambulatory. Patients in their initial episode of pain should have prolonged conservative treatment. A large proportion of them will get well without surgery.

Air-Borne Infection — Air Sterilization. R. J. V. Pulvertaft.

Brit. M. J. **4526**:517 (Oct. 4) 1947.

We now approach a more vexed question, the sterilization of air by antiseptic mists and smokes by ultraviolet light. At the outset it must be stressed that both of these methods are effective only or at least mainly against droplets and droplet nuclei. This is often overlooked, for the greater part of the experimental work has been with organisms sprayed from fluid suspensions in the air.

The lamps may be used in many ways. For the sterilization of wards and living-rooms it is convenient for them to be above eye-level, and they must be mounted so that no rays are directed below this level.

The Americans have been using ultraviolet rays for air sterilization for many years. It is a standard equipment in many schools and hospitals. Wells calculates that it is equivalent to 500 turnovers of air per hour, compared with the 25 turnovers by the best ventilation. In groups of schools the incidence of susceptibility to measles in an epidemic was from 9 to 15.5 per cent in irradiated schools. Similar results have been found with chicken-pox. Experimentally, rabbits have been protected against air-borne tuberculosis. It is the opinion of the author that ultraviolet light is the simplest and most efficient technic of this kind, and has no objectionable features if the eyes and skin are not irradiated.

Treatment of Rheumatoid Arthritis.

Ann. Int. Med. **28**:125 (Jan.) 1948.

The recent trend has been to deprecate artificial fever therapy. Of 74 patients, treated thereby (104 to 105 F. rectally for six sessions of three hours each; Kettering hypertherm) 44 per cent showed immediate improvement, but in only 18 per cent was it sustained after six months. Osborne, Markson, Driscoll and Merriman submitted 27 patients to six, or eight sessions of hyperpyrexia at 104 F. for four hours, induced by electromagnet. Improvement was marked in 22 per cent, moderate in 22 per cent, slight or none in 56 per cent; follow-up results were not reported. Concentrations of ascorbic acid in plasma were changed notably by induced hyperpyrexia. Typhoid vaccine reactions were as effective as prolonged artificial fever. Prolonged fever induced with typhoid vaccine given by intravenous drip was again described.

Many general articles appeared. The value of home physical therapy by simple means (radiant heat, contract baths, and douches, wet packs, par-

affin baths, hot tub baths and others) was stressed.

Occupational therapy is concerned mainly with the restoration of joint motion and muscle strength; it provides the patient with something constructive or useful to do, thereby ridding him of a feeling of helplessness and dependency. Movements involving extension rather than flexion should be encouraged.

Early Ambulation Evaluated. Louis J. Regan.

Hospitals **22**:37 (Jan.) 1948.

The practice of early ambulation in the major hospitals of Los Angeles has practically doubled the number of patients cared for; it has permitted the hospitalization of thousands of persons who otherwise could not have been handled. The savings have been immeasurable, in pain and in lives. The great dividend has been physical, mental and financial benefit to the thousands of patients whose stays in hospitals were fewer and whose convalescences were hastened. Early ambulation means to cause to walk or move about early in relation to some event or time factor.

Electric Convulsive Therapy in Stammering. Thelma V. Owen, and Marguerite G. Stemmermann.

Am. J. Psychiat. **104**:6 (Dec.) 1947.

To illustrate the value of the pluralistic approach to the problem of stammering a case is reported in detail in which psychotherapy, speech training, and electric convulsive therapy were utilized. The dominant psychoneurotic traits were amenable to psychotherapy only after convulsive treatment released the patient's inner tension. Electric convulsive therapy is recommended in the management of severe stammering to shorten the period of treatment and to induce a more suitable atmosphere for both psychotherapy and speech reeducation.

Acute Effects of a Hot, Saturated Atmosphere Upon the Human Temperature, Heart Rate and Blood Pressure, as Influenced by Age. Vernon J. Miller, and Fred B. Moor.

Brit. J. Phys. Med. **10**:170 (Nov.-Dec.) 1947.

From a group of 1,000 patients to whom 6,500 individual sessions of artificial fever therapy had been given, 113 syphilitic patients were selected and divided into age-groups by decades. From the clinical fever records of these patients, 236 treatments were chosen for tabulation and study to ascertain the effects of a hot saturated atmosphere upon the temperature, heart rate and blood pressure during the five age-decaded from ten to sixty years.

There was great similarity in the temperature responses to the hot saturated atmosphere at the various age levels. The time required to reach a therapeutic temperature of 105 F. was sixty-five to ninety minutes in all groups, with an average cabinet temperature of 115 F. The average maintenance temperature was 110 F.

The reaction of the heart rate to the hot, saturated atmosphere was not uniform for all the age-groups. The pulse-temperature ratio was slightly higher for the third and fourth decades than for the first, fifth or sixth. The same was true for the CHR/CBT value described by Benson.

There was no significant difference in the response of the blood pressure to the hot, saturated atmosphere in the various groups. All showed a slight primary rise in the systolic pressure, lasting approximately two hours, and then a gradual decline to a point below the previous normal. The diastolic pressure consistently fell to a level ranging on the average from 25 to 50 millimeters Hg.

Early Manifestations of Multiple Sclerosis. B. W. Lichenstein.

Am. Prac. **2**:197 (Nov.) 1947.

According to Lichenstein there is no agreement on either the cause or the cure of multiple sclerosis. For many years fever therapy with typhoid-paratyphoid vaccine and mechanically induced fever were in vogue. At a later date quinine sulfate was used rather extensively. Since the advent of vitamin B and particularly thiamine chloride, untold quantities have been poured into patients with multiple sclerosis. Of late the histamine and "dicumarol" treatments have become fashionable. In Lichenstein's opinion the acute attack with excessive fatigue should be treated with rest, eradication of foci of infection and adequate diet. The prognosis in multiple sclerosis is not as grave as many believe. Some persons have two or more mild attacks and never go on to development of the advanced form of the disease. Others continue to have recurrent attacks with severe involvement of the nervous system followed by permanent defects.

Biochemical Applications of Stable and Radioactive Isotopes. A. S. McFarland.

Brit. M. J. **4532**:7661 (Nov. 15) 1947.

The developments, which are largely if not exclusively derived from isotopic studies, represent substantial contributions to biochemistry. They reveal numerous unsuspected metabolic pathways and if some of these are but little used normally, for example, the fixation of CO, they may be of the greatest importance in disturbed metabolic states; e. g., in diabetes, where acetoacetate and related ketone bodies are produced in abnormal amounts. They demonstrate that the quantity of substance in a tissue bears little if any relation to its metabolic importance and that important intermediary metabolic may not even be present in detectable concentrations, thereby heralding a new dynamic point of view in which the body is conceived as in a state of incessant change, atoms and molecules displacing one another with surprising rapidity in every tissue. All that remains constant is the pattern into and out of which atoms pass — a stereo-chemical relationship of atoms within molecules, and a spatial juxtaposition of molecules within tissues — which is specific, for each individual and characteristic of living as a whole.

Electrophysiology as Applied in Physical Medicine. Arthur L. Watkins.

Brit. J. Phys. Med. 10:172 (Nov.-Dec.) 1947.

There has been considerable recent progress in the field of electrophysiology, which has been made possible by advances in electronic instrumentation. In physical medicine those studies related to nerve and muscle function are of the most clinical interest, particularly in view of the occurrence of many nerve injuries as a result of World War II, and are the subject of this paper.

Recent advances in electrophysiology as applied to physical medicine have made possible clinical measurements of value in the diagnosis of a large variety of neuromuscular disorders. These include quantitative determination of excitability thresholds and recordings of electrical discharges from muscles with disordered innervation.

The Management of Battle-Incurred Compound Fractures in the Region of the Hip Joint. Marshall R. Urist.

Military Surg. 101:467 (Dec.) 1947.

Active exercises were seldom possible or practical in compound fractures of the head or neck of the femur during the first twelve weeks of healing. In 2 cases in this series, however, passive and active exercises were begun guardedly and gradually at eight weeks.

Moderate passive exercises while the patient was in suspension were usually encouraged during the first month of healing. Quadriceps-knee exercises were supervised by physical therapy aids from the beginning of treatment in all cases.

Early Postoperative Ambulation. Charles H. Mead.

Minnesota Med. 31:40 (Jan.) 1948.

Early postoperative ambulation is designed to maintain normal physiologic functions of the body after surgical treatment. The procedure denotes activity starting in the first six to twenty-four hours after operation, encouraging the patient to be up and about with continuation of normal physiologic processes.

Curare in Oil in the Treatment of Spastic Conditions. C. Astley Clarke, and R. D. Hotston.

Brit. M. J. 4545:289 (Feb. 14) 1948.

The therapeutic possibilities of curare in diseases of the central nervous system have been considered for nearly a century, but because of the dangers of the drug it was originally used only in desperate cases of tetanus and hydrophobia. The present investigation was conducted with a view of confirming Schlesinger's conclusions in general neurologic cases. Seventeen patients were selected for treatment, the only criteria being that their spasticity should be of the pyramidal type and that it should be their chief disability. The series comprised one case of traumatic quadriplegia, one of spinal cord compression, one of motor neuro disease, one of subacute combined degeneration, and 13 of disseminated sclerosis.

Reviewing 17 cases it was found that in 11 the treatment either produced no improvement (7) or the patients were actually worse (4). The reason for definite deterioration appears to be that curare by lessening spasticity sometimes unmasks previously concealed posterior column loss. Turning to the cases in which improvement was noted, the only remarkable success was in Case 1. Here curare in oil was of no use until it was reinforced with quinine, but the combination of the drugs resulted in cessation of the flexion spasms, which did not return when the drugs were stopped a month later. (It may be worthy of note that all cases in which favorable results were reported by Schlesinger were traumatic in origin.) In the remainder of the cases which were thought to be improved the benefit was slight and usually only apparent to the patient. It was difficult to assess minor fluctuations in muscular power, and interrogation of patients showed that there was considerable natural variability: thus hot weather and previous exercise both resulted in temporary improvement. Another factor which had to be borne in mind, particularly in dealing with disseminated sclerosis, was natural remission. Even more important was the psychologic aspect of the treatment. Most of the patients had been chronically ill for long periods, and when fresh hope was engendered by the new drug, intensive physical therapy, and the encouragement of being a center of interest once more, there was a natural tendency to think the treatment was doing good.

Bearing all these factors in mind, the authors do not feel that the improvement noted in six of their cases can with any certainty be attributed to tubarine, particularly as 11 showed no benefit whatever. In their opinion, therefore, curare in oil is not the hoped-for advance in reducing spasticity in neurologic disease, and they do not feel that their results justify the expense of the treatment, at any rate so far as adults are concerned. They have not used the drug in children, but it seems likely that the same disadvantages would obtain, and a recent communication on the subject of reablement in Little's disease makes no mention of its use. Further investigation is necessary to see whether a combination of drugs is any more successful. The value of curare in oil in reducing spasticity of pyramidal type in 17 cases of neurological disease has been investigated. In the opinion of the authors the drug has not proved superior to aqueous curare and has been of little use in the rehabilitation of their patients.

Some Facts to Consider in Evaluating the Treatment of Poliomyelitis. John A. Toomey.

Brit. J. Phys. Med. 10:185 (Nov.-Dec.) 1947.

Success in treating the patient is attributable not so much to any particular method of therapy, but rather to persistent meticulous application of principles of physical therapy early in the disease and for a long time thereafter, by someone trained in physical therapy who is particularly interested in poliomyelitis and its treatment.